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Recital of automatic bottle filling system in food and preparation of beverages college/industry using plc and scada.

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Abstract -In this modern world, people are running behind two things, one is of nanotechnology and another is of automation. The reason is to move ease of our work and to improve the efficiency of the working by limiting (or) decreasing size. Here in this paper, we are about to develop a system which will govern the task of filling water into bottle being supplied to it. This operation is controlled by PLC, monitored by SCADA. In our traditional method, only one bottle can fill at a time. In this paper, our system is programmed by ladder programming. In this process, the proximity sensor is used to detect the position of the bottle that move along the belt conveyor. The reference signal is the input signal that has been sending from the sensor to the PLC. The output will be as per the user requirement. As it is a programmable controller the input is the program, therefore it reduces complexity and troubles when compared to mechanical working (conventional mechanism) advantages is high accuracy, deduction (or)reduction in wastage of products (water, cool drinks).It has a various application such as beverage industry, mineral water filling.To make automated bottle filling machine to achieve both accuracy and speed in the filling, is a requirement of the time.

Keywords: Automation, bottle filling, sensor, PLC, SCADA

I. INTRODUCTION

Automation is considered to have a wide impact by colleges, industries and other developing fields rather from manufacturing. To reduce the human need in production and manufacturing sector by the implementation of automation which uses control system and information technology. Totally Integrated Automation covers the complete production line, from receipt of goods, the production process, filling and packaging, to shipment of goods. This paper is designed to develop the “New approach for small-scale beverage preparation and bottling unit using PLC and SCADA. Beverage preparation and bottle

filling mechanism is controlled and operated with the help of PLC. Here the process is monitored through SCADA technology as SCADA technology is used to monitor the process through modern animation. With the help of PLC, several operations will be eventually operated. At the initial process, the pump feeds the water to the process water tank from the purified water reservoir. In the second process the bottles filled with the beverage moves to the packaging unit by a conveyor which will move by a conveyor motor. The system is complete of automation; therefore it performs with flexibility and reliability. Our paper is also an application of automation wherein we have developed a bottle filling and capping system. Thus the processes are controlled using a PLC (Programmable Logic Controller) and is monitored using SCADA (Supervisory Control and Data Acquisition).

Basic parts of a PLC are: (A) Input devices (B) CPU (C) Monitor (D) Output devices (E) Programming Unit (F) Power Supply.

II.OBJECTIVE

- To reduce the human intercession in the processes to widen and design a Bottle filling and Capping plant using various sensors.
- Automatic filling process for all the bottles simultaneously with a user defined selection for volume to be filled.
- To design the SCADA screen for the monitoring of the purpose.

III.ALGORITHM

- **PROCESS 1:** Press the “START” push Button.

- **PROCESS 2:** Then the “MOTOR” starts and the container moves forward.
- **PROCESS 3:** Container is made up of any metal (eg: tin, silver etc.) the bottle will be pushed by the piston.
- **PROCESS 4:** Container is made of non-metal (eg: plastic) then it will move forward and will stop below the solenoid valve.
- **PROCESS 5:** After some delay, the valve will turn “ON” and the bottle will get filled.
- **PROCESS 6:** After the bottle is filled, a delay is provided and then after the delay the motor.
- **PROCESS 7:** The bottle is moving forward, the cap will be placed by the cap hopper automatically
- **PROCESS 8:** After the cap is placed the bottle will move further and the bottle will stop below the capping piston.
- **PROCESS 9:** After some delay, the capping piston will come down and the cap will be placed tightly.
- **PROCESS 10:** After the cap is placed the bottle will go further for different processes in college.
- **PROCESS 11:** Press the “STOP” push Button.

IV.EXPERIMENTAL SETUP

Fig.1 shows the complete process of automatic bottle filling system. First, the empty bottle is sent into the filling unit by the conveyor. The proximity sensor senses the bottle whereas position sensor checks the perfect position to fill it. After getting signal from the proximity and position sensor the solenoid valve operate for the time period that mentioned in the programming.

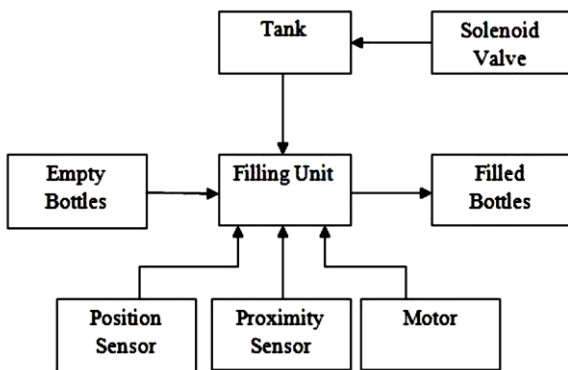


Fig 1: Automatic filling process

Fig.2 Automatic filling control system

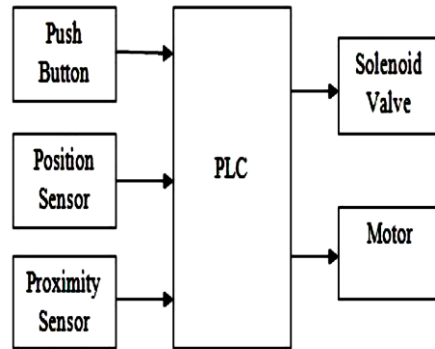


Fig.2 shows the control system for automatic filling system

PLC: PLC as the control centre of filling system

Sensors: It includes proximity and the position sensor for detecting an object and checking the position of the object.

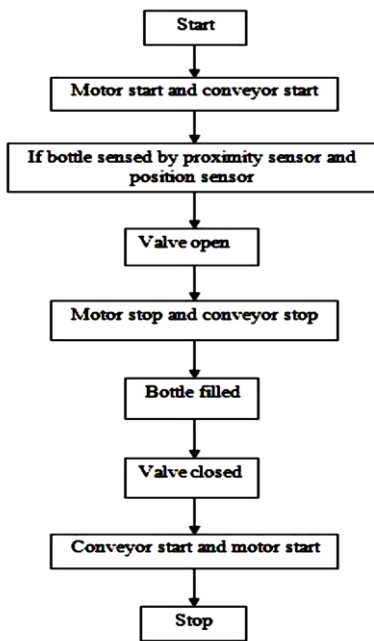
Solenoid Valve: The valve opened for the time as given in PLC program.

V.METHODOLOGY

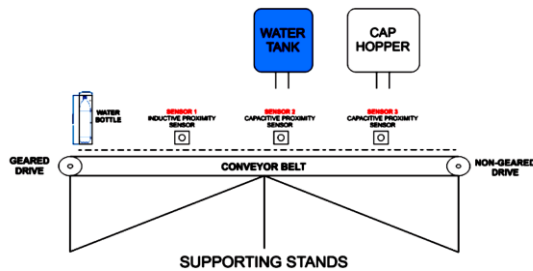
This work has a complete application of mechanization. These processes are controlled by PLC and monitored by using SCADA. PLC and SCADA are the important part of the bottle filling the system. As the system controlled according to the programmed PLC and SCADA is used to monitor the process in system. This system utilizes a start/stop control of the engine when we on the switch then motor gets started. Bottles are kept in conveyor line which will be attached to the motor. When a motor is switched on then conveyor will start moving. At the point when bottle goes under the tank then a sensor senses the bottle and the valve open for the specific time period as programmed in the programming for that time the liquid filled into the bottle. The rate gets affected by the position of the valve. The required filling operation depends on user categorized volume through which user can pick the volume of fluid to be filled.

Here a clock added in which that gave a period esteem for filling a container. Based upon the pre-set value of the timer the valve is switched on for that specific timeframe and the filling is finished.

Fig 3: Process flow chart



VI. PROCESS DIAGRAM



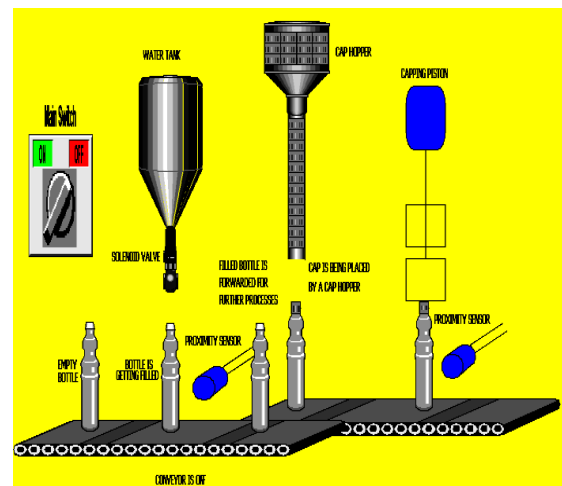
VII.PROCESS DESCRIPTION

A. Programmable logic controller (PLC):

PLC is also known as solid state device. The range of task is well adapted to the system. All control operations are performed using the PLC. The entire bottling process is automated by feeding the accurate condition into the PLC using ladder logic. Ladder logic is also considered to be one of the methods of programming a PLC. Thus depending on the logic developed the fillings of bottles are performed. PLC is the most useful and usage controller unit in automation systems. PLC's are arguably the most important tool for control of automated production systems. PLC is a powerful controller and allows monitoring and available with SCADA software. Economical life and usage, programming, design feature and design requirements that selecting PLC for the main control unit.

B. Supervisory control and data acquisition (SCADA):

SCADA stands for “Supervisory Control and Data Acquisition. These codes were either written in assembly language or relay logic without any true animation that would explain the process running. With the improvement of SCADA we can now analysis the graphical animation of the entire process and also can control. Now days all the control systems are coupled with HMI or SCADA as it gives an animated view by sitting at one place while the process is at another place.



C .Inputs:

Input interface modules accept signals from the sensors. The input includes the proximity sensors, float switch, position sensor and starts/stop switches. The output of all the sensors is used as input to PLC. The proximity sensor uses to detect the presence of bottle. A Sensor placed before filling unit from where the empty bottles pass. The position sensor used to sense the position of the bottle on a conveyor. Float switch used for the liquid tank by which the level in the tank can be maintained. Float switch output gives starting and stopping of water pump. Push button used to start and stop the cycle.

D .Float switch:

Float Sensor is an electrical ON/OFF Switch, which operates automatically when the liquid level goes up or down with reverence to the specific level. The Signal thus available from the Float Sensor can be utilized for control of a Motor Pump or an allied electrical element like Solenoid, Lamps, and Relays etc.

E. Outputs:

The variety of output devices used in the bottling process are pumps, gear motor, actuators and LED's. These are connected to the output module. The gear motor is used to run the conveyor in the forward direction. There are nearly three pumps used for the filling process. One pump is connected to the filler and the other pumps are connected to the reservoir to retrieve the water. The bottles are capped by the actuator. A force is applied by the actuator over the cap which in turn plugs the bottles tightly. These are the various output devices used in the bottling process.

Solenoid Valve: It is an electronically controlled valve used to control the water by opening and closing routinely.

F. Bottle intimation using sensors:

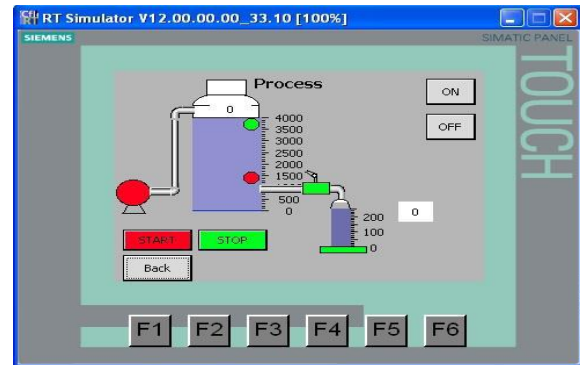
on the respective holders, the bottles are placed on the conveyor. The presence of bottles in the holder is initiated by IR sensor. The filling and capping operation takes place based on the output of the sensors. A timer is employed in order to check the status of the bottles. For example if bottle 1 is present the corresponding status bit in PLC is set to 1 else it is set to 0 in the display. The outputs of these sensors are given to the PLC and depending on this output the filling and capping operation over the bottles takes place. Thus if all the n number of bottles are present in the input side of the conveyor then the sensor gives the corresponding output to the PLC which in turn switches ON the corresponding pumps for filling operation to take place. If a particular bottle is absent then the corresponding pumps remain OFF.

G .Bottle filling operation:

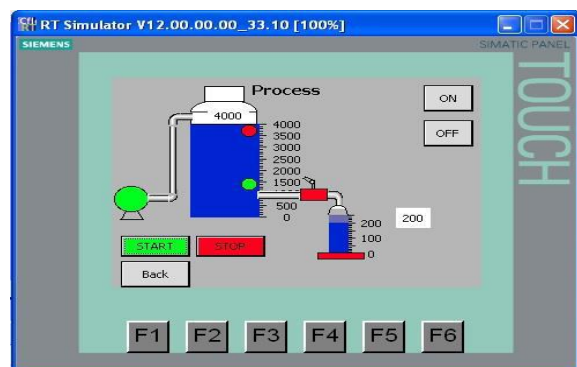
When the bottles are detected in the input side, the conveyor motor switches ON and it starts moving in the forward direction. The bottles then reaches the required position for filling and the conveyor stops moving. The equivalent pumps in process tank switch ON and filling operation takes place. For e.g. if only bottle 1 is present then pump 1 switches ON and conveyors motor switch off. Then the liquid reaches particular level in the bottle the pump switch off and the conveyor motor will switch on. Process tank has three level sensors (LLS, HLS and MLS). When the water in the reservoir tank reaches below low level sensor (LLS) pumps in reservoir switches on then the bottle get filled. MLS is used to denote the middle level of the tank .When the level of water reaches high level sensor (HLS) the pumps in reservoir switch off.

H.Model design:

The bottle filling machine worked and controlled under SCADA software. SCADA software is available for powerful monitoring to sending with the system status. Siemens TIA V12 including WinCC advanced being used because of S7 series PLC synchronized and worked properly with this. In WinCC library there are much application written those programming languages which are used make a new project for industrial control. When starting the application with WinCC the application details and PLC programming output signals are determined. After that tags made for the system used with WinCC library. S7 1214 PLC CPU was communicated with PC. When uploaded the program PC to PLC CPU, WinCC control centre worked properly. WinCC started with the cycling and monitoring application on the PC monitor. So WinCC is critical operation on this process.



Pump OFF, empty tank in TIA



Pump ON, empty tank in TIA

VIII.LIMITATIONS

- It is limited that only certain number of bottles can be filled.
- As required by the industry/college this system is not so fast and hence results in lacking productivity.
- This system is not so healthy as demanded by the industries/colleges; also this system only fills liquid for a particular bottle of same height and width

FUTURE WORK

We are about to develop the system to next level by overcoming the limitation and reduces it's drawback, by increasing the performance of the system with oncoming technologies.

- As an alternative of two port valves, we can use a jet nozzle for the bottle filling purpose since it will reduce the time of filling operation.
- The aim of the system is to increase the productivity with the reduction in time.
- The alarm system can be added to indicate the malfunctioning of components.
- We can brighten up the whole system again for a new bottle or any other specification.
- Different features like capping, counting, packaging can also be affixed to this paper.
- Laser sensors can be installed to indicate a defective bottle being put on the conveyor belt.

CONCLUSION

The Goal of this paper is to create a PLC and SCADA based automatic bottle filling system plant based on given report. During this paper, we gained knowledge about various processes directly consume in industries/colleges such as automation system in which we particularly learned about programmable logic controller (PLC) and SCADA(Supervisory Control and Data Acquisition). Various concepts in PLC and SCADA were understood including its working operation assembly, selection of PLC, programming of PLC (Ladder programming) etc. Generally, the goal of our paper was to fill the bottles and then pass them to the production line which was successfully consummate. This knowledge is growing fast and will be very famous in the coming years. Mainly PLC and SCADA is used for the controlling and monitoring purpose but we can also control functions like starting or stopping the conveyor from the system. This attribute is above all very useful in case if some fault occurs in the system.

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