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AUTOMATIC BOTTLE FILLING AND CAPPING SYSTEM USING PLC

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Abstract: An Automation is the utilization of different control techniques for operating equipment's such as operations in factories and other applications with reduced human power. The filling process is a mission performed by a machine that fills liquid products such as water or cold drinks. Traditional bottling methods include placing bottles on a conveyor belt and filling only one bottle at a time. In this project, we are implementing an "Automatic Bottle Filling and Capping" and are dedicating to the industries. In this project we are using PLC which is a brain of this entire project. The main work it will do is the filling and capping of the bottles used in industries for the various purpose such as pouring fluids (such as milk, water etc.) in a packing bottles, toxic chemical containers stored in bottles without any injuries.

Keywords: *Toxic Chemical, Packing, Capping, PLC.*

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I INTRODUCTION

Filling is the task that is carried out by a machine and this process is widely used in many industries such as milk industries, chemical, food, mineral water etc. The objective of this paper is to design, develop and monitor "Bottle fillingand capping with PLC". This work provides a lot of benefits like low power consumption, low operational cost, less maintenance, accuracy etc. The main work it will do is the filling and capping of the bottles used in industries for the various purpose such as pouring fluids (like milk, water etc.) in a packing bottles, toxic chemical containers stored in bottles without any injuries. A prototype has been developed to illustrate the system. Here, the filling of the bottle is controlled by using a controller known as Programmable Logic Controller (PLC) which is also the heart of the entire system. For the conveyor system, a DC motor has been selected for better performance and ease of operation. Proximity sensors have been used to detect the position of thebottle. Ladder logic has been used for the programming of thePLC, which is the most widely used and accepted language for the programming of the PLC. The whole system is monitored and controlled by SCADA.

II IMPLEMENTATION METHODOLOGIES

Initially Bottles are loaded in mixer. It'll arrange bottlesin proper manner to travel on conveyor belt. There is an arrangement of Optical proximity sensor which will detect bottle on conveyor belt send signal to PLC whichstarts Gear DC motor of conveyor. Bottles on conveyor passes to the liquid filling unit, proximity sensor will detect presence of bottles which in-turns ON water Pump and open solenoid valve from which liquid is fed to Bottle. Filled bottles goes towards capping unit, at which caps are automatically placed on top of the bottle and then by the capping Unit bottle is properly capped. To check the bottle is properly capped or not Capacitivesensor is used.

Whole process is controlled and monitored by SCADA.It also has ability to stored data and reuse when needed.

III COMPONENT AND SPECIFICATION

Programmable Logic Controller (PLC)

Programmable logic controller is a microprocessor based to store instructions and logics. In this project, PLC is usedinstead of arduino because it is more convenient to use PLC than arduino. Again, more flexible and more reliable operations can be performed by using PLC. The change of program is so much difficult in arduino micro controller

whereas PLC ladder logic can be changed very easily if necessary.
PLC Used in this is MICROLOGIX 1400 has 8 input and 16 output digital type.

Figure 1 Micrologix 1400 AB PLC

- **GEARED DC MOTOR**

Main moto of using geared dc motor is that it can sustain more load, run with higher efficient speed as we are using gear dc motor to move conveyor belt it has to carry empty as well as liquid filled bottles sometimes which could heavy in weight.

High torque 12v dc gear motor is Used.

Figure 2 12V Gear Dc Motor

- **STEPPER MOTOR AND DRIVE**

A stepper motor can be a good choice whenever controlled+ movement is required. They can be used to advantage in applications where you need to control rotation angle, speed, position and synchronism., stepper motors have found their place in many different applications. Some of these include printers, plotters, high-end office equipment, hard disk drives, medical equipment, fax machines, automotive and we use it in our system.

NEMA 23 Stepper Motor SpecificationsVoltage Rating: 3.2V.

Current Rating: 2.8A Holding Torque: 270 oz. inStep Angle: 1.8 deg

Steps Per Revolution: 200No. of Phases: 4

Motor Length: 3.1 inchesNo. of Leads: 4

Figure 3 NEMA 23 Hybrid Stepper Motor

Figure 4 TB6600 Stepper Motor Driver

- **OPTICAL PROXIMITY SENSOR**

A complete optical proximity sensor includes a light source, and a sensor that detects the light. The light source is supplied because it is usually critical that the light be "tailored" for the light sensor system. The light source generates light of a frequency that the light sensor is best able to detect, and thatis not likely to be generated by other nearby sources. Infra- red light is used in most optical sensors. To make the light sensing system more foolproof, most optical proximity sensor light sources pulse the infra-red light on and off at a fixed frequency. The light sensor circuit is designed so that light

that is not pulsing at this frequency is rejected.

The light sensor in the optical proximity sensor is typicallya semiconductor device such as a photodiode, which generates a small current when light energy strikes it, or morecommonly a phototransistor or a photo-darlington that allows current to flow if light strikes it. Early light sensors used photoconductive materials that became better conductors, and thus allowed current to pass, when light energy struck them.

Figure 5 Optical Proximity Sensor

- **CAPPING UNIT**

Capping head is arranged at the top of hybrid stepper motor which also act as linear actuator. Capping head will be direct in contact of bottle's cap.

When bottle arrive at capping unit the motor's shaft willrotate in forward direction to tight cap of bottle.

- **SOLENOID VALVE**

Solenoid valv**es** are control units which, when electrically energized or de-energized, either shut off or allow fluid flow. The actuator takes the form of an electromagnet. When energized, a magnetic field builds up which pulls a plunger or pivoted armature against the action of a spring.

Figure 6 Solenoid Valve

- **CONVEYOR BELT**

Conveyor belt will carry the empty as well as filled bottles to filling and capping station. It is made up of steel material has length 0.7m and width 0.015m. There are two such Conveyors are used.

- **DC WATER PUMP**

DC pump is used to move the water in different ways by using direct current from motor, battery or solar system. In this project, this pump is used for continuous water flow at low pressure. In this study, Transistor, Rectifier Diode, Resistor is also used for various purposes.

IV BLOCK DIAGRAM

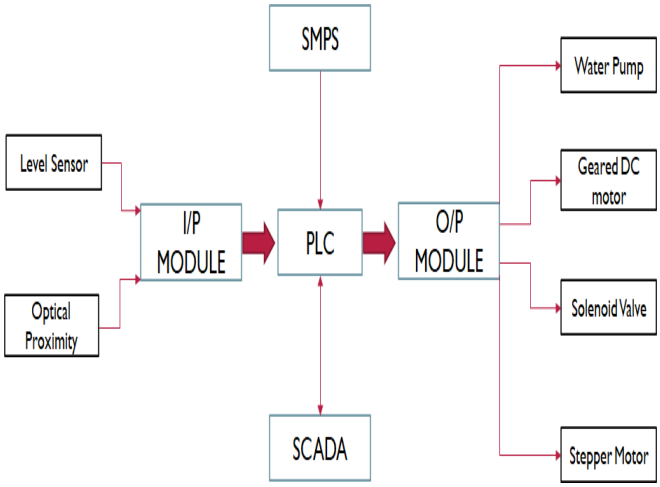

Figure 7 Block Diagram

Initially Bottles are loaded in mixer. It'll arrange bottles in proper manner to travel on conveyor belt. conveyor passes bottle to the liquid filling unit, proximity sensor will detect presence of bottles which in-turns to open solenoid valves from which liquid is fed to bottle without stopping conveyor. Filled bottles goes towards capping unit, at which caps are automatically placed on top of the bottle and then by the Capping unit bottle is properly capped. To check the bottle is properly capped or not Capacitive sensor is used.

V ADVANTAGES & DIS-ADVANTAGES

- **ADVANTAGES:**
  - Low Power consumption
  - Low operational cost
  - Less maintenance
  - High Productivity
  - Reduce human intervention
  - More accuracy
  - Improved Safety & security

- **DIS-ADVANTAGES:**
  - High capital cost.
  - Skill labour required.

VI FLOW DIAGRAM

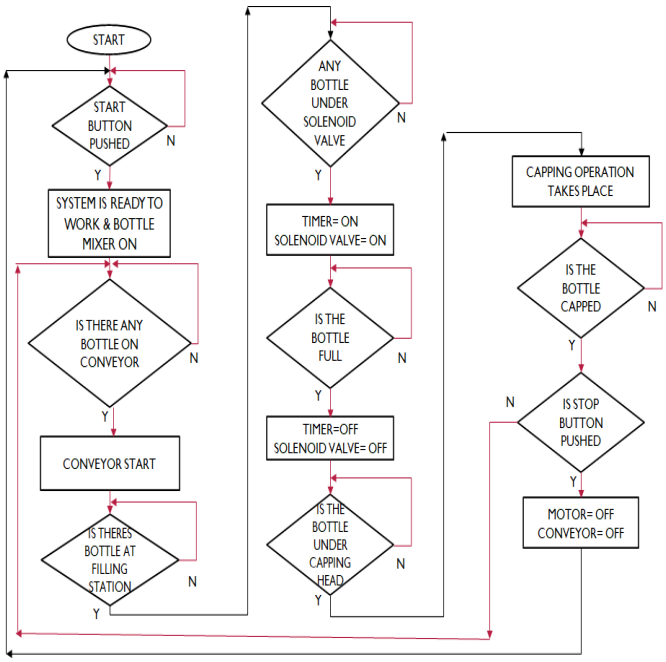

Figure 8 Flow Chart

VII CONCLUSION AND FUTURE SCOPE

- **CONCLUSION**
  - The main objective of this project was to develop a bottle filling, labelling and capping system based onPLC & SCADA.
  - PLC was used to control the various operations and monitoring was done using SCADA.
  - We specifically learnt about Programmable Logical Controller (PLC) and SCADA.
  - More features can be added to this system as follows: depending on the size, shape and weight ofthe bottles, filling and capping operations can be implemented.
  - The system is designed to working with different sized bottles by simply adding Liquid grid sensor.
- **FUTURE SCOPE**
  - With the help of proper and efficient components,the drawback of productivity can be overcome.
  - More bottle will be filled, this will reduce the timeand increase productivity.
  - Alarm function can be added in case of any mis-operation.
  - The system can be redesigned for increase bottlesize and productivity.

VIII REFRENCES

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