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Automatic Bottle Filling System Using Plcand SCADA

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Abstract: This paper outlines a novel approach on the automatic bottle filling using PLC and SCADA. A total interface using the necessary hardware such as push button, PLC, valve, relay and software such as RSVIEW 32, RSLOGIX.
All the necessary details from interfacing to implementation and prototypes to results have been discussed below.
Index-Terms: Automatic bottle filling, PLC, SCADA, Proximity switch, Relay.

I. INTRODUCTION

In this new technological era automation has always played a major role in the industries in developing the productivity and reducing human effort beyond our expectation. Automation is the combination use of control system and technology to reduce human effort. Automation has outpaced mechanization where humans work with hand and use of muscular strength to operate the machinery. It has not only played an important role in the industrial world but also an increasingly important role in the developing the world economy. One of the most important applications of automation is in the soft drink and other beverage industries, where a measured amount of particular liquid is to be filled in bottles. This can prove to be a difficult job without having an automated system capable of doing it. Today the beverage industry are moving towards complete automated solution starting from manufacturing, quality testing control, monitoring productivity, shipping, and to shipment delivery tracking. Our research is an application of automated system which will reduce human effort in beverage filing in the manufacturing unit. We have developed a bottle filling automated system with specific quantity. This automated system is controlled and operated using a PLC (Programmable Logic Controller) and is monitored using SCADA (Supervisory Control and Data Acquisition).

II. HARDWARE PLATFORM

The hardware part mainly consists of a digital computer, PLC micrologix 1000, PNP inductive proximity switch, 12v dc motor, and 24 v dc solenoid valves, normally open (NO) &normally close (NC) push button 110V ac, 4 NO & 4 NC relay which is being discussed along with their specific functions.

Plc micrologix 1000

The microLogix 1000 [1-2] family provides small, economical programmable controllers. The I/O options and electrical configurations make them ideal for many applications. Based on the architecture of the market-leading SLC 500 controller family, the microLogix 1000 brings high speed, powerful instructions and flexible communications to applications that demand compact, cost-effective solutions. They are available in configurations of 10 digital I/O (6 inputs and 4 outputs), 16 digital I/O (10 inputs and 6 outputs), 25 I/O (12 digital inputs, 4 analog inputs, 8 digital outputs, and 1 analog output), or 32 digital I/O (20 inputs and 12 outputs) in multiple electrical configurations of digital I/O.Analog versions are also available with 20 digital I/O points and 5 analog I/O points. The analog I/O circuitry for the microLogix 1000 units is embedded into the base controller, not accomplished through add-on modules. So, it provides very high-speed, cost-effective analog performance. Below is the snapshot of the PLC micrologix 1000 used in, (Fig no: 1).

Fig1: The snapshot of the PLC micrologix 1000

2. PNP inductive proximity switch

Non-contact detection of metallic object is detected by the proximity sensor. Their operating principle [3] is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface. The presence of a metallic object (actuator) in the operating area causes a dampening of the oscillation amplitude. The rise or fall of such oscillation is identified by a threshold circuit that changes the output of the sensor. The sensing feature depend on the material used to be sensed and the distance between the sensor and the object. The iron is the most efficient and copper be the least. The frequency depends on the maximum number of on or off cycle in one second. Below in, (Fig no: 1.1).the frequency graph and in (Fig no: 1.2), snapshot of the proximity switch used in our research.

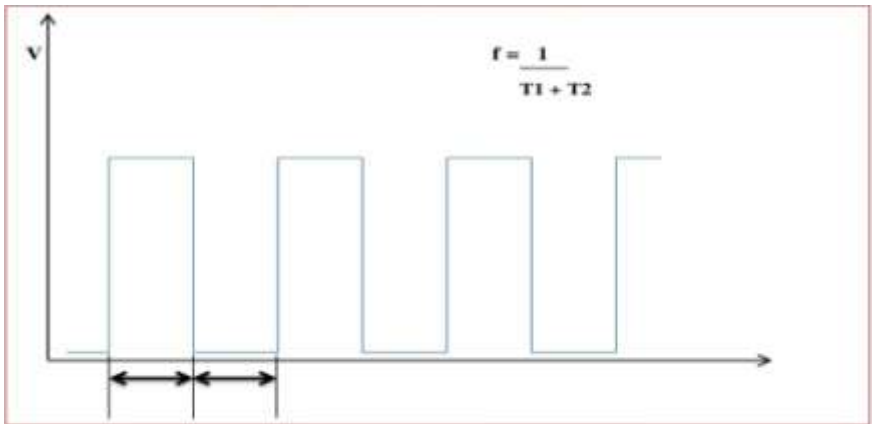

Fig1.1: The frequency graph

Fig1.2: The snapshot of the proximity switch

3. 12v dc motor

A DC motor actually converts [4-5] the electrical power to mechanical power. A current carrying armature which is connected to the supply end through commutated segments and brushes it is placed within the north south poles of a permanent or an electro-magnet. Most dc motor produces rotary motion. A linear motor directly produces force and motion in a straight line. The working principle is based on the Fleming's left hand rule, which can be used to determine the force acting on it. The magnitude of the electromagnetic field produced can be changed by the change in magnitude and direction of the current flowing through the motor.

4. 24v dc solenoid valve

A solenoid valve [6-7] is an electromechanically operated valve it is controlled by an electric current through a solenoid. Most solenoid valves operate on a digital principle on two distinct states first when the valve is initiated by electric current and the second when it is in resting phase i.e. without electricity. The functions are defined from the resting position. The solenoid may have two types of function as given below.

A. Normally closed (NC)

The solenoid is said to be normally closed (NC) [8-9] when there is no flow across the valve in the resting position with no current on solenoid contact. Below the circuit diagram of normally closed is given in, (Fig no: 1.3).

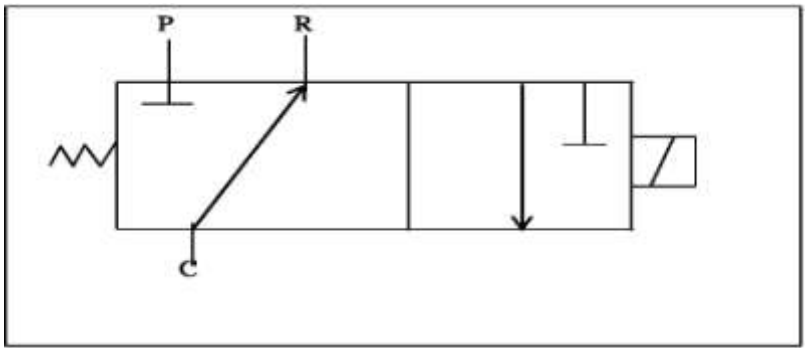

Fig1.3: Circuit diagram of NC

B. Normally open (NO)

The solenoid is said to be normally open (NO) [10-11] when it enables liquid to pass through the valve in resting position with no current on solenoid contact. Below the circuit diagram of normally open is given in, (Fig no: 1.4).

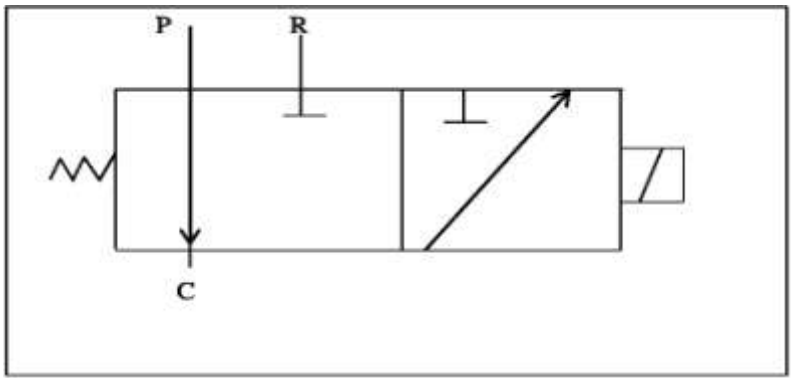

Fig1.4: Circuit diagram of NO

5. Normally open and closed push button

Normally open (NO) [12] push button is the button which makes no electrical contact in the steady state i.e. till the button is not pressed. When the button is pressed down it makes electrical contact with the circuit in which it is used. The electricity can only flow to the circuit when the button is pressed. In our project the 10 amp NO is used.The normally closed (NC) [13] push button makes electrical contact with the circuit even in the steady state. When the button is pressed down it makes no electrical contact with the circuit so it becomes an open circuit. In our project 10 amp NC is used.

6. Normally open and closed relay

Relay is an electromagnetic device [14-15] is used to connect two circuits magnetically while isolating electrically allowing one circuit to switch another circuit while they are completely separate. Relay is mainly used for interfacing a circuit working at a low voltage to a circuit working at high voltage. A relay switch can be divided into two parts i.e. input and output section. Input section generate a magnetic field on application of low voltage in the circuit which is also called operating voltage of the relay switch. The output section mainly consists of several contractors which connect or disconnect mechanically. In a relay there are three contactors i.e. normally open circuit (NO), normally closed circuit (NC) and common circuit (COM).In the normally open circuit (NO), power flows out if the relay is activated but if the relay is deactivated power stops flowing. In normally closed (NC), power flows out if the relay is deactivated but if the relay is activated the power flow stops. In our project we have used 4 NO and 4 NC 230V ac relay.

III. METHODOLOGY

In this paper our main aim is to purpose the model of automatic water filling system the system comprises of two sections the input section and the output port. The input module consists of NO and NC push button and the proximity sensor and the output module consists of the 230V (2) ac relay connected to the output end of the PLC micrologix 1000 and the valve with is connected to the motor of 12 v dc supply. The proposed architecture is shown below in, (Fig no: 1.5).

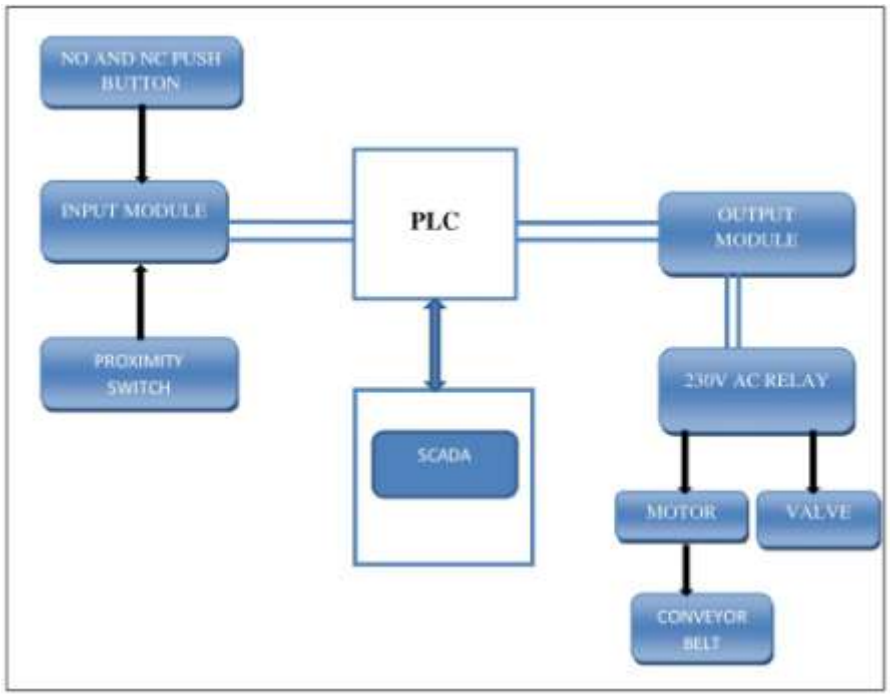

Fig1.5: Proposed architecture of the system

When motor is started using normally open (NO) push button the conveyor starts. The bottle placed over the conveyor starts to move. When the bottle (metal body) reaches near the vicinity of the proximity switch it detects the metal body and the motor stops and simultaneously the valve opens for water filling. The system pauses for 10 seconds.After 10 seconds the motor again starts to move and the valve closes. The system stops using the normally close (NC) button. This can also be used as emergency stop button in case of any emergency system failure. The working flowchart is given below in (fig no: 1.6).

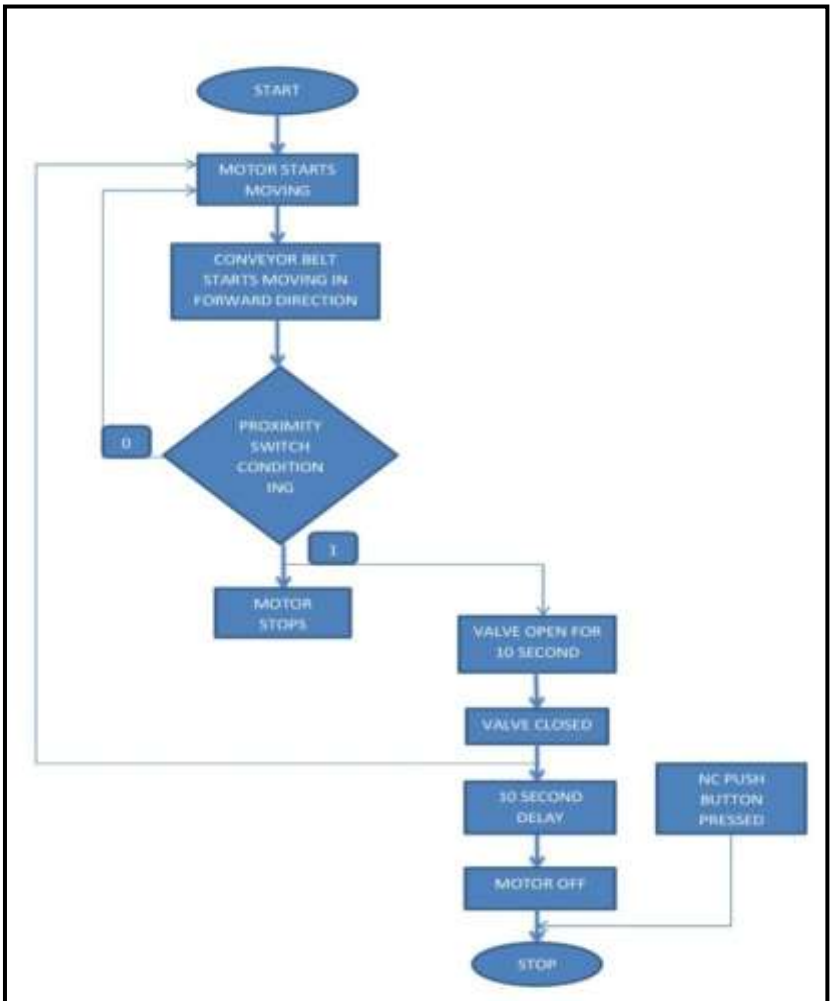

Fig 1.6: Working principle flowchart

1. Interfacing with PLC and SCADA

Supervisory control and data acquisition (SCADA) [16] is a system for remote monitoring and control that operates on the principle ofunique coded signals over communication channels (using typically one communication channel per remote station).when the control system is combined with a data acquisition system by using the coded signal over communication channel it can be used to retrieve information about the status of the equipment remotely for display or for recording functions. The main purpose of using SCADA is to get a graphical and animated view and control using the software installed. All the advanced control systems used today are coupled with HMI or SCADA as is gives an animated view of the whole working system remotely. In our project we have implementedRSView32 bit SCADA. Various protocols [17] are used for the interfacing of the PLC and the server. There are lot of protocols used for serial communication. We have used serial protocol i.e. RS-232 for serial communication. The inputs and outputs are connected to the PLC and they function on the ladder logic given by the user. The primary advantage of SCADA is that we can implement limited control options remotely. Below (Fig no: 1.7) provide the block diagram of interfacing of PLC and SCADA.

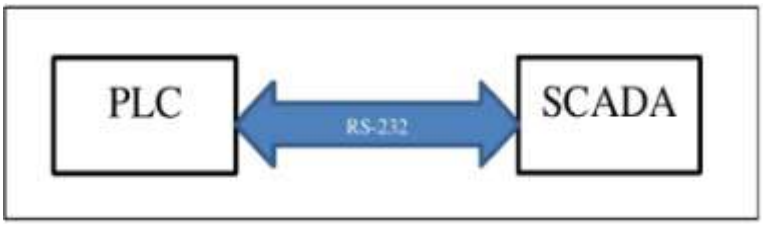

Fig 1.7: Interfacing of PLC and SCAD

2. Relay drive

The operating voltage [18] of the output devices is low when compared to that of the PLC. PLC used in this project is micrologix 1000. Its operating voltage is 230v. The operating voltage of motor and valve is only 12v. Hence the output signals from the PLC are given through a 230 v ac relay drive unit which drives the output devices by supplying the optimal voltage necessary for their operation. The 12V required for their operation is available at the common terminal of the relay unit.

3.SCADA implementation

SCADA used in our research to control and supervise the system remotely. Below is a snapshot in (fig no: 1.8) of the SCADA.

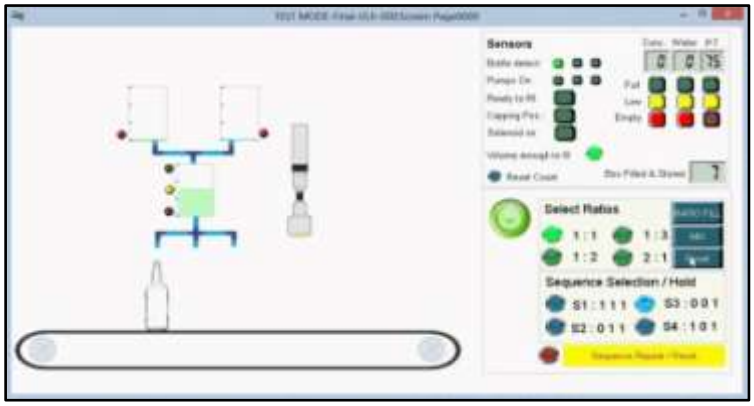

Fig 1.8 snapshot of SCADA implemented

IV. EXPERIMENTAL EVALUATION

In order to implement and demonstrate the system developed theoretically, we created a prototype that represents the system. Thus the whole system that is being developed is given below, (Fig. no: 1.9)

Fig 1.9: The prototype model

V. DISCUSSION AND CONCLUSION

The main objective of this paper was to develop an automatic water filling system using PLC and SCADA. This was successfully implemented. It also gives us a basic idea about the manufacturing process of the beverage companies. The implementation of Programmable Logical Controller (PLC) makes the entire system far more efficient than basis microcontroller. Implementation of SCADA has been very useful in maintaining the system remotely. The safety system installed makes it more reliable. Implementation of automation enhances productivity which in turn decreases the manufacturing cost. Although the initial cost of this project is high but it can be a lot cost effective in the long run. A lot of additional features like user defined volume specification and additions of different liquid in same bottle with volume specification can be added. Continuous filling process with more safety protocol can also be added. In this project desired goal is achieved.

REFERENCES

[1]. http://www.ab.com/en/epub/catalogs/12762/2181376/2416247/1239746/2159695/Introduction.html
[2]. http://www.jsec-tw.com/rockwell/1761-td001b-en-p.pdf
[3]. http://www.fargocontrols.com/sensors/inductive_op.html
[4]. https://en.wikipedia.org/wiki/DC_motor
[5]. http://www.electrical4u.com/working-or-operating-principle-of-dc-motor/
[6]. https://en.wikipedia.org/wiki/Solenoid_valve
[7]. http://www.pacontrol.com/download/Solenoid%20Valves%20Basics.pdf
[8]. http://www.asco.com/ASCO%20Asset%20Library/asco-2-way-2-position-intro.pdf
[9]. http://in.mathworks.com/help/physmod/hydro/ref/hydraulicallyoperatedremotecontrolvalve.html
[10]. http://www.engineeringtoolbox.com/normally-open-d_880.html
[11]. http://plastomatic.com/failsafe-explained.html
[12]. http://www.learningaboutelectronics.com/Articles/What-is-a-normally-open-push-button
[13]. http://www.learningaboutelectronics.com/Articles/What-is-a-normally-closed-push-button
[14]. http://35f0bb988ac1c90ba28f-dd6e0920ea8c2dee42f6c0a73a2e5b5a.r70.cf5.rackcdn.com/triton-relays-normally-open-vs-normally-closed.pdf
[15]. http://www.autoshop101.com/forms/hweb2.pdf
[16]. https://en.wikipedia.org/wiki/SCADA
[17]. AnupDakre , Junaid G. Sayed , Ekata A. Thorat , AousafAhamad Md. Aves Chaudhary"Implementation of bottle filling and ccapping using PLC and SCADA" International Research Journal of Engineering and Technology(Volume: 02 Issue: 09 Dec-2015)
[18]. DheerajPongallu, Prof. S. R. Suralkar "Automatic multivariate liquid filling system & conveyor control using PLC & SCADA" International Journal of Emerging Technology and Advanced Engineering (Volume 4, Issue 12, December 2014)