Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2020, 7(6):57-61**

Review Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Automatic Batch Mixing using Allen Bradley PLC and SCADA

Deepak Vyas, Ashok Jat, Aniket Sisodiya, Vijayendra Singh Sankhla

Department of Mechanical Engineering GITS, Udaipur, India

Abstract In the era of industrial revolution many industries started production using automated machines. In order to streamline operations in terms of acceleration, reliability and system output industrial automation is necessary. Automation plays gradually important role in today's economical world. We have used Programmable logic controller (Allen Bradley PLC) and SCADA for our project to lower the operational cost, power consumption and operational time and increase accuracy and flexibility to the system. We have used ladder diagram for this purpose. Using automated system productivity and quality is increased and chances of human error is reduced to great extent. Traditional method of batch mixing is doing it manually using measurement and then filling them in bottles which results in time-consuming, consistency and accuracy of the process also effected due to high human error. Programmable logic controller (Allen Bradley PLC) based automated batch mixing system can be used to automate the control and mixing of two different liquid with different properties in predefined proportion. It results in better quality and productivity by controlling human intervention. Medicinal syrup manufacturing industries, colour mixing industries, milk industries, chemical industries, mineral water industries and many more industries can adopt automation in mixing different fluid by this project. The main aim of the paper is to plan, develop and test the real time implementation of Allen Bradley PLC, SCADA systems for ratio control based liquid mixing and bottle filling.

Keywords Allen Bradley PLC, SCADA, Proximity Sensor, DC Motor, Level Sensor

Introduction

Automation is becoming the backbone of control engineering in recent days. It plays an important role in world economy and day to day life. Making industrial system or process automatic by reducing human interference in it is called automation. Mixing different liquid is very common process in paint industry, medical industry, chemical industry, pharmaceutical industry etc. With the help of machinery liquids is mixed with accurate proportion of constituents accurately and effectively. The entire process is controlled and automated with the help of Allen Bradley PLC. Allen Bradley PLCs are widely used in automation industry and process control systems due to its ability for being user programmable. To prevent industries from accidents due to overflowing of tanks automatic liquid level controller are used which are designed to automate, monitor and control liquid level in tank. Level controller are also used in various industries and even for household purpose to automatically control motor which result in saving water from overflow situations. The input is given from Allen Bradley PLC to the control valve. According to the ladder program the valve will work and controls its flow. To reduce the errors caused by humans SCADA is used for monitoring. Various types of machines are programmed by Allen Bradley PLC (programmable logic controller) for monitoring the internal storage of instruction, for the implementing functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analog input output modules. We are also using data acquisition system and supervisory control for reducing cost, wastage and production time.

Proposed System

Allen Bradley PLC is the main controller which store all information and control the process. It can also be called as brain of the complete system. In order to control machine and process Allen Bradley PLC implement functions like logic, sequencing, counting, timing and arithmetic. It also uses programmable memory to store instructions. Machines used here belongs to Allen Bradley series which provide high speed, stability and reliable application. For indicating level of liquid level switches are used. If level is above the switch then it is open and if level is above the switch it is in close condition. 12V DC motor are used to mix different liquid which is supplied by output relay drive unit. When the object is detected the proximity, sensor detects and sends the signal to Allen Bradley PLC. Out of Inductive, capacitive and ultrasonic sensor we have used capacitive sensor which detects the presence of object. To control flow of liquid solenoid valve are used. It is a flow control valve which contains electromagnetic plunger.

Input is given by Allen Bradley PLC to the valve. When the tank is full then only the valve is on. To control and monitor the physical process Supervisory Control and Data Acquisition system (SCADA) is used which enhances the automation.

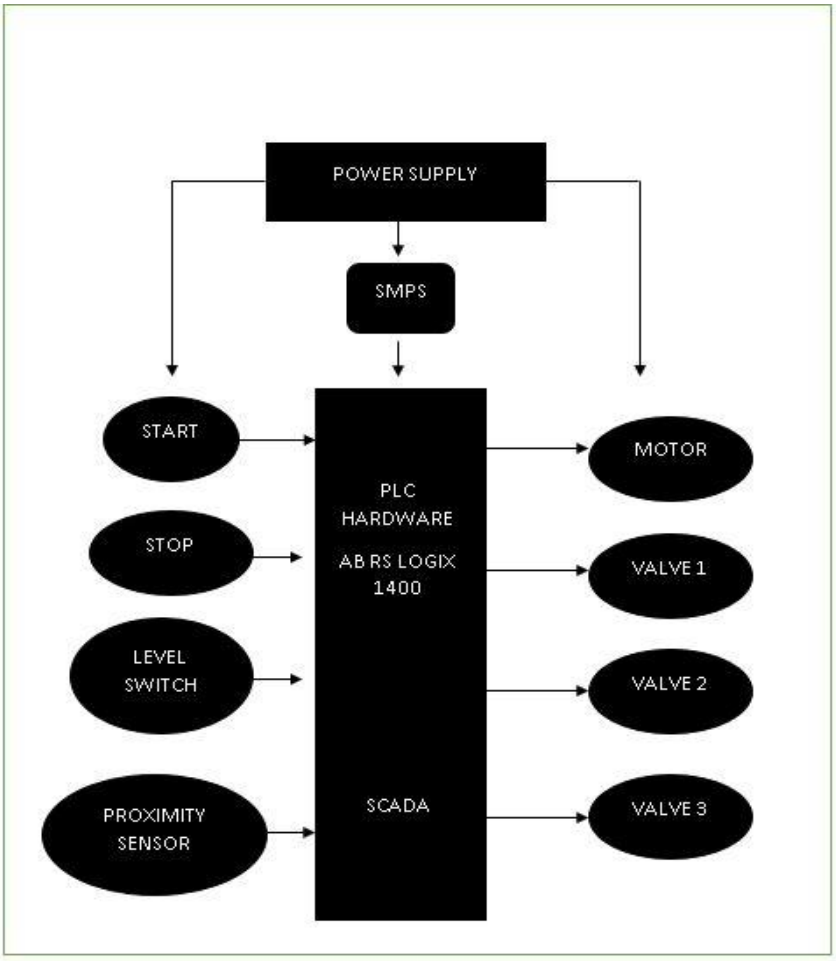

Figure 1: Block diagram of proposed system

Elements used in System

1. Allen Bradley PLC (Programmable logic controller): Allen Bradley PLC are used to control the machine and its processes for that it uses a programmable memory to store instructions and for implementation of functions such as Timing, counting, logic, sequencing and Arithmetic. Allen Bradley PLC are connected to various input devices like switches and output devices like motor and to control the process controller monitors the input and

output according to program stored in it. The whole system is controlled by the AB RS LOGIX1400 ALLEN BRADLEY PLC.

2. Level Switch: To determine the level of liquid level switches are used. The tanks contain the two types of Level switches for indicating the level of liquid i.e. High-level switch and low-level switch. Motor turns ON only when liquid comes at high level switch and mixing is done. Continuous and point level measurements are two type of level measurement mostly used. In this system we use the Point level measurement that only determines if the liquid level is high or low depends on that valve is turn ON/OFF.

3. Proximity Sensor: Capacitive proximity sensors are non-contact devices that can detect the presence or absence of material. The capacitance of this oscillator is linked with sensing face and when object moves into operating zone its capacitance activates the oscillator.

4. DC Motor: 12 Volt DC motor is used for mixing of fluids. Motor starts when the high-level sensor is ON and the mixing process is done with the help of stirrer. The motor will stop according to the time given in the program.

5. Control Valve: Allen Bradley PLC gives input to the control valve. They are connected to the liquid tank. When the upper tanks are filled up to the level switch then only. Valve opens and liquid comes to the third tank when liquid comes at high level switch. After that the third valve is open for the timing set in the program. We can change the ON time as per our requirement.

6. SCADA: SCADA (Supervisory Control and Data Acquisition) is a control system containing of computers, networked data communications and graphical user interface for high level process supervisory management by using other peripheral devices such as Allen Bradley PLC and PID controllers to interface to the system. These allow separate parts of a complex process to have individual control. The real time control logic is performed by networked module which connects to the field sensor and actuators.

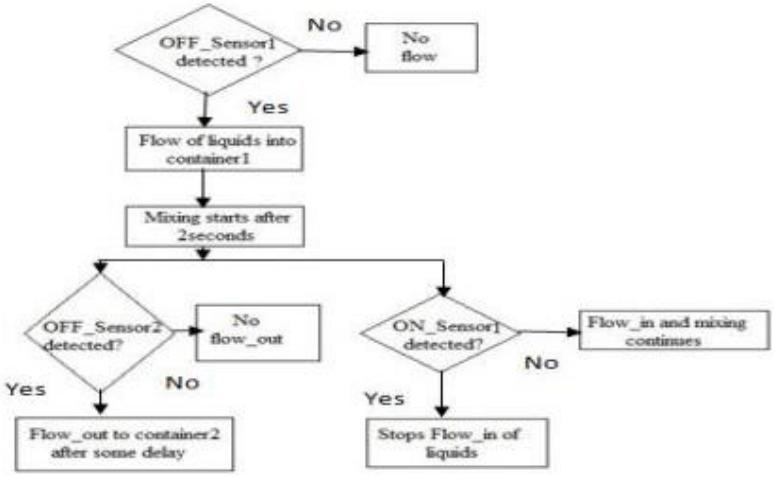

Figure 2: Block diagram of mixing process [1]

Algorithm for the process [3]:

1. Starting of the process.
2. Checking the inlet of fluid A & B.
3. If LS1 & LS2 of fluid A & B is high then solenoid valve A & B is ON else go to step (2).
4. If LS2 & LS4 of fluid A & B is low then solenoid valve is OFF. Else go step (3).
5. If fluid in tank C then turns ON motor for 20 sec. else repeat this step.
6. If motor is done check for temperature.
7. If temperature is more than hold the system for some time to observe the mixture.
8. If temperature is low go to next step.
9. If bottle is present at outlet solenoid valve C is ON (if bottle is not there place it manually)
10. Turn count 1-100.
11. Repeat the process.

Results

Ladder Programming: Ladder logic is used to develop software for programmable logic controllers (Allen Bradley PLCs) used in industrial control applications. With relay-based control systems the ability to monitor Allen Bradley PLC logic in ladder diagram format also made troubleshooting easier. Although there are many higher-level languages now available for Allen Bradley PLC programming, the majority of systems are still programmed in ladder diagram format.

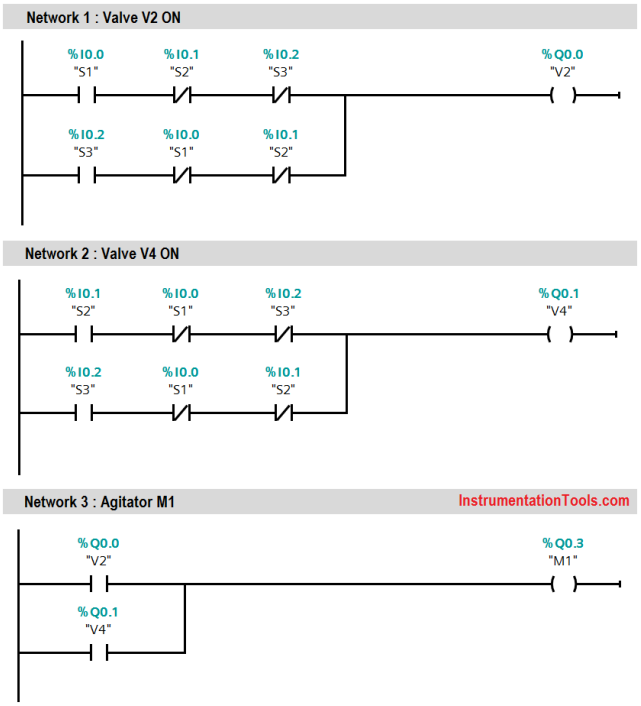

Figure 3: Ladder diagram of mixing process [2]

Advantages [3]

- System is accurate & proportional mixing of liquid can be seen.
- As compare to manual process it has Reduced operating costs.
- Increased production.
- Time efficient because it is fully automatic system.
- Efficient & easy Maintenance.
- Same system used for different purpose.

Applications [3]

- Food processing technology
- Beverage processing industry
- Concrete industry
- Paint industry
- Chemical industry
- Cold drink manufacturing industries.
- Petroleum industry.

Conclusion

Industrial fluid mixing technique is one of the several applications of the programmable logic controller to the control of an industrial process. Through the Allen Bradley PLC based on the user defined ladder logic program the time for the operation of mixing, level control and bottle filling are controlled. The automatic batch mixing process using Allen Bradley PLC and SCADA can be adapted for use in the industrial applications because of

its ease of use, flexibility, accuracy and effective method of automated control. The proposed system has worked effectively without unnecessary spill or wastage of liquids. multiple number of liquids may be mixed in varying proportions although proposed system illustrates the mixing process of two liquids.

References

[1]. Pallavi K. Sajjan and Anand Unnibhavi, PLC based Automated Flow Control in Cold Drinks Manufacturing, Industry (Received 16 September, 2016 Accepted 19 October, 2016).
[2]. https://in.pinterest.com/instrumentationtools
[3]. Prof. Ajay Gadhe, Priti Bhojane, Kaveri Kawade, Chemical Mixing for Process Industry Using PLC& SCADA, Vol. 7, Issue 4, April 2018.
[4]. Prof. Swapnil R. Kurkute, Mr. Akshay S. Kulkarni, Mr. Mahesh V. Gare, Mr. Soham S. Mundada, Automatic Liquid Mixing and Bottle Filling - A Review, Vol. 4, Issue 1, January 2016.
[5]. https://www.scribd.com/document/396489009/Development-of-Barbot-Automatic-Drink-Mixer-and-Dispenser-Machine
[6]. https://www.ecmweb.com/content/article/20889663/what-to-know-about-plc-ladder-diagram-programming
[7]. https://scadamotion.com/scada-technology/
[8]. https://nakuzha-ceria.blogspot.com/2008/11/
[9]. www.wikipedia.com