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Chemical Mixing For Process Industry Using PLC & SCADA

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ABSTRACT*:* In the past few years, after the Industrial revolution industries have adopted several automated machines for its purpose. In our project it is done by Programmable Logic Controller (PLC) and SCADA. This work will provide low operational cost, low power consumption, accuracy and flexibility to the system and at the same time it will provide accurate volume of liquid in bottle by saving operational time. The system sequence of operation is being designed by ladder diagram. Automating repetitive tasks in the industries increases the productivity. It reduces the probability of error and maintains product quality. Traditional methods of mixing fixed quantities of different types of liquids and filling them in bottles involve manual mixing of the constituent components based on measurements and bottling of the mixture as desired. Manual handling of such tasks is time consuming expensive and often lack consistency in product quality due to human errors. A Laboratory Prototype of a Programmable Logic Controller (PLC) based automated liquid mixing and bottle filling system is designed to automate the control and mixing of two different liquids in predefined proportion and filling the generated mixture in bottles to achieve quality control reduce human intervention and improve productivity. The main goal of proposed system is to adopt automation in the mixing industries like medicinal syrup manufacturing industries, colour mixing, and food industry.

KEYWORDS: PLC, SCADA, Proximity Sensor, DC Motor, Level Sensor

I. INTRODUCTION

Automation is one of successful field in today's world and it has become the backbone of control engineering. Automation plays an increasingly important role in the world economy and in daily experience. The goal is to provide plant operators and engineers the tools to monitor and control their plant more efficiently. Automation is nothing but taking a system or process and making it automatic by eliminating human work as much as possible. Mixing of liquids is a common process in the paint industry; medical industry; chemical industry; pharmaceutical industry etc. The most important step in mixing the liquid is defining the accurate proportion of constituent liquid element; which can be effectively and accurately performed with the help of machinery without manual intervention. This system is designed for automated level control; liquid mixing and filling of bottles. The system is designed for filling the mixture of two liquids in equal proportion. It consists of three sub system namely level controller; liquid mixer and bottle filler. The entire process is controlled and automated with the help of PLC. PLCs are widely used in automation industry and process control systems due to its ability for being user programmable. Automatic Liquid level controller is designed to automate, monitor and control liquid level in the tank with the aim to reducing cost and human intervention along with prevention of industrial accidents due to overflowing of the tank. Level controllers are used for different industries as well as domestic household purpose to automatically control the operation of motor thereby avoiding wastage of resources. Automated liquid mixer performs mixing of different liquid in predetermined proportions. The input to the control valve is given from the PLC. According to the ladder program the valve will works and controls it's flow.

II.PROPOSED SYSTEM

Here PLC is the brain of the system. A PLC is digital electronic device that uses a programmable memory to store instruction and to implement function such as logic, sequencing, timing, counting and arithmetic in order to control machines and process. Allen Bradley series offer high speed, stable and highly reliable application in all kinds

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of industrial automation machines. The PLC is main controller used for storing these all information and controlling purpose. Level switch is used for indicating the level of liquid. When the liquid level is below the switch then it is normally open condition while when liquid is above the switch then it is closed condition. The Proximity sensor detects and sends the signal to the PLC when the object is detected in the operating zone. There are different proximity sensors like inductive, capacitive, and ultrasonic. We have used capacitive sensor which detect whether the object is present or not. The DC motor is used for mixing purpose of liquid. The motor requires 12V DC for its operation which is supplied by output relay drive unit. Solenoid valve are the flow control valve with electromagnetic plunger which control the flow of liquids. The input to the valve is given by PLC. When the tank is full then only the valve is ON. The SCADA is the Supervisory Control and Data Acquisition System. SCADA system is used to control and monitor physical process. The automation is further enhanced by constant monitoring using SCADA.

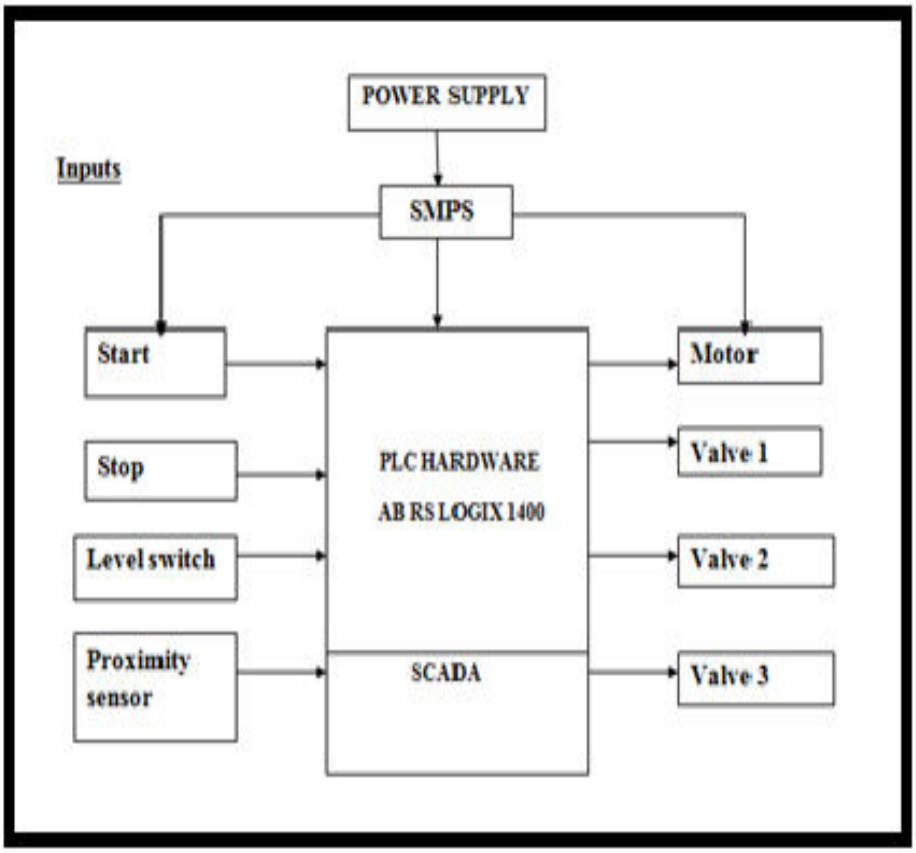

Fig. 1: Block diagram of Proposed System

2.1 Elements of block diagram are as follows:

1. Programmable Logic Controller (PLC):

PLC is Digital Electronic Device that uses a programmable memory to store instruction and to implement function such as Timing, Counting, Logic, Sequencing and Arithmetic in order to control the machine and their processes. Input devices e.g. switches, and output devices e.g. motor being controlled are connected to PLC and then the controller monitors the input and output according to the program stored in the PLC by operator and control the process. PLC is main controller used for storing these all information and controlling purpose. The whole system is controlled by the AB RS LOGIX1400 PLC.

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2. Level Switch:

Level Switch is used for determining the level of liquid. The tanks contain the two types of Level switches. They are high level switch and low level switch for indicating the level of liquid. When liquid comes at high level switch then only the motor turn ON and mixing is done. There are two types of level measurements, they are continuous and point level measurements. 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 sensor is designed to detect and react to any object which moves into operating zone. The sensor contains an oscillator. 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:

DC motor is used to mixing purpose. When the high level sensor is ON then only motor starts and the mixing process is done with the help of stirrer. The motor will stop according to the time given in the program. For that specific time only motor on and the mixing process is done. The motor will operate at the voltage 12 VDC.

5. Control Valve:

Input to the control valve is given by the PLC. Control valves are connected to the liquid tank. When the upper tanks is filled upto the level switch then only valve is open and liquid comes to the third tank. At the third tank when liquid cones at high level switch then 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 is Supervisory Control and Data Acquisition is a control system that uses computers, networked data communications and graphical user interface for high level process supervisory management but uses other peripheral devices such as 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.

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III.FLOWCHART

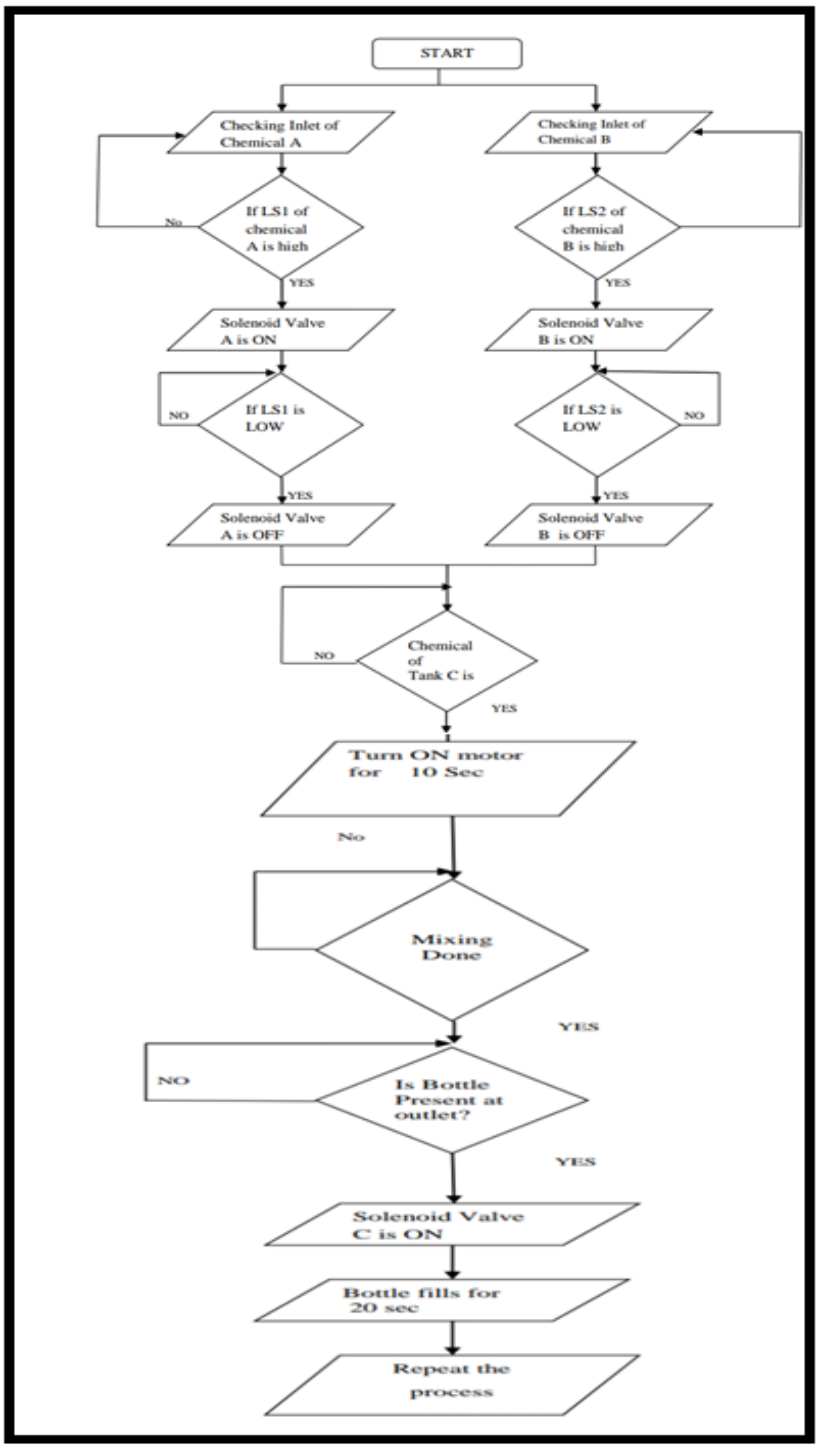

Fig. 2: Flowchart of System

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3.1Algoritm

1. Start.
2. Checking the inlet of syrup A & B.
3. If LS1 & LS2 of syrup A & B is high then solenoid valve A & B is ON. Else go to step (2).
4. If LS2 & LS4 of syrup A & B is low then solenoid valve is OFF. Else go step (3).
5. If syrup in tank C then turns ON mixer for 10 sec. else repeat this step.
6. If mixer is done. Check for temperature.
7. If temp is above hold the system for some time to observe the mixture.
8. If temp 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.

IV.RESULT

4.1 Ladder Programming:

The Programming method of PLC (Programmable logic controller) is graphical method which is called as ladder logic. And the programming is called as ladder programming. The ability to monitor PLC logic in ladder diagram format also made troubleshooting easier for those already familiar with relay-based control systems. Although there are many higher-level languages now available for PLC programming, the majority of systems are still programmed in ladder diagram format because of these advantages.

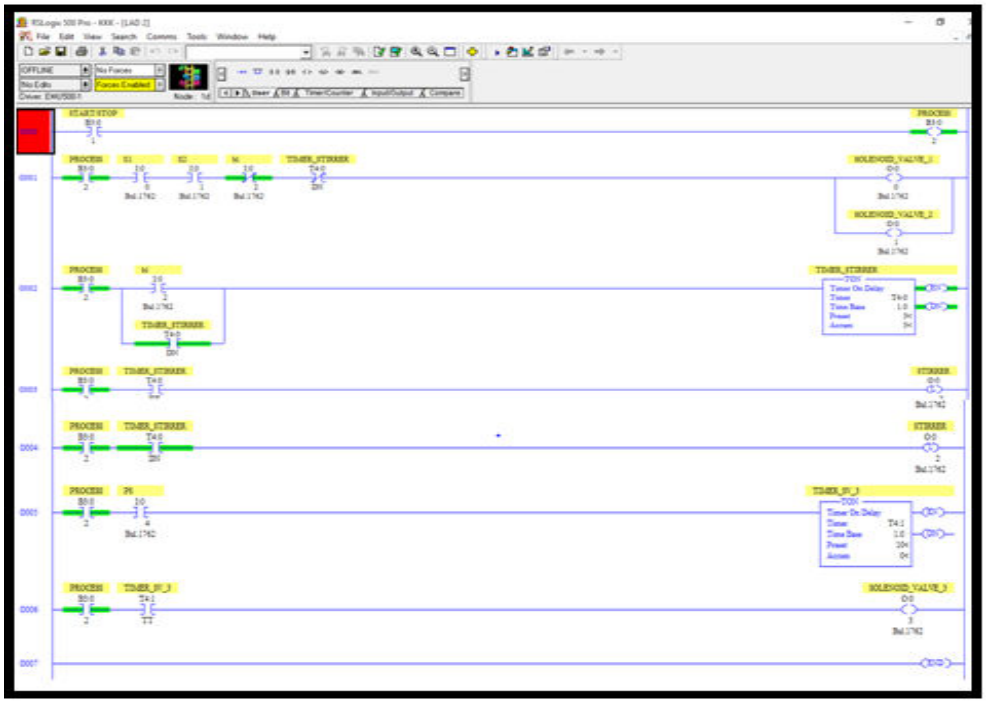

Fig. 3: Ladder Programming

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4.2 Complete setup of system:

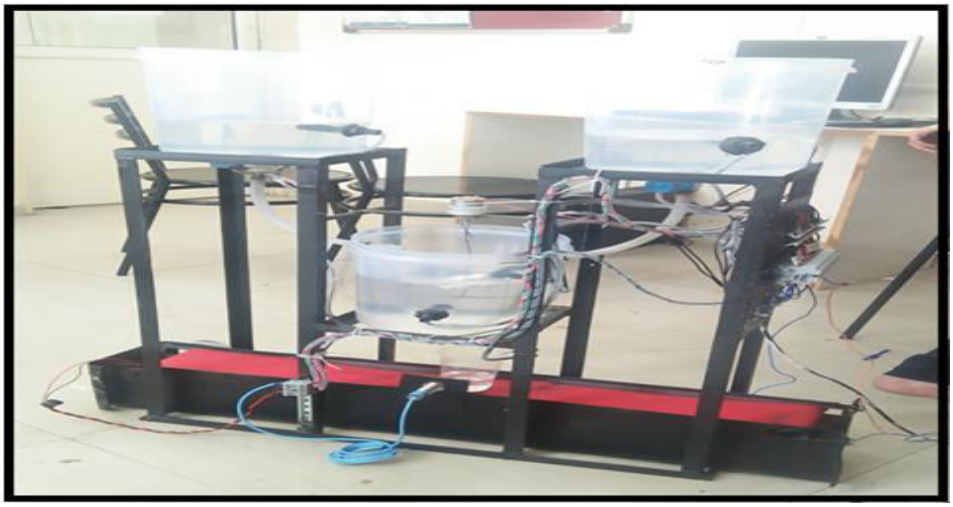

Fig. 4: Complete setup of system

V. ADVANTAGES

- Accurate & Proportional mixing of liquid.
- Reduction in operating costs as compare to manual process.
- Increasing production.
- Fully automatic system so that quality production achieved in less time.
- Efficiency & Maintenance easy.
- Same system used for different purpose.

VI. APPLICATIONS

- Food processing technology
- Beverage processing industry
- Concrete industry
- Paint industry

VII. CONCLUSION

Industrial mixer is one of the several applications of the programmable logic controller to the control of an industrial process. The duration for the operation of mixing, level control and bottle filling is controllable through the PLC based on the user defined ladder logic program. The developed laboratory prototype can be adapted for use in the industrial applications because of its ease of use, flexible, accurate and effective method of automated control. The proposed system has proved to work effectively avoiding unnecessary spill or wastage of liquids. Although proposed system illustrates the mixing process of two liquids, any number of liquids may be mixed in varying proportions.

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