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Optimized Preparations of Chemical Mixtures Using PLC and SCADA

[1]Satyen Naik, [2]Joshua Dias, [3]Josivo D' Costa, [4]Jubilio Martin, [5]Brenner D' Costa

[1,2,3,4,5] Electronics and Telecommunication Department, Don Bosco College of Engineering, Fatorda – Goa, India

***Abstract*: This paper presents the idea of using PLC and SCADA in industrial automation. The use of PLC is a major factor to create a move towards operations affected by less noise and other aspects of improving efficiency in industry. The drawback of current industry automation and the need for new design principles is to take advantage of these technologies such as PLC and SCADA. The goal of this paper is to find out whether PLC and SCADA render any significant benefits to industry automation improvements and how these benefits reflect to higher standards. In this paper a prototype system has been designed to automate the mixture of chemicals with the aim of optimizing the efficiency, precision and consistency of the mix. The PLC is the main controlling body and the dc motor controls the conveyor belt. To accomplish this system, dc motor, solenoid valves and position sensors are used. SCADA software is used for monitoring the process and for data acquisition**

***Keywords:* PLC, Conveyor Assembly.**

1. INTRODUCTION

Optimized preparation of chemical mixtures is automated by using a PLC (Programmable logic controller) . Programmable Logic Controller (PLC) is a small computer used for automation of real-world processes, The PLC usually uses a microprocessor. The program can often control complex sequencing and is often written by engineers. The program is stored in battery-backed memory and/or EEPROMs. Unlike general-purpose computers, the PLC is packaged and designed for extended temperature ranges, dirty or dusty conditions, immunity to electrical noise, and is mechanically more rugged and resistant to vibration and impact. By implementing this project we decreases man power, thus increase in production of the industry.

Using this system we can mix chemicals efficiently in various industries such as pharmaceutical, petroleum, paint, etc. This is automated using the PLC. This system can be used in harsh industrial conditions .The working is explained with the help of a flow chart

II. DEFINITION OF PLC

A 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 processes. The term logic is use primarily concerned with implementing logic and switching operations .Input devices e.g. switches, and output devices e.g. motors, being controlled are connected to the PLC and then the controller monitors the inputs and outputs according to this program stored in the PLC by the operator and so controls the machine or process.

Originally they were designed as a replacement for hard-wired relay and timer logic control systems. PLCs have the great advantage that it is possible to modify a control system without having to rewrite the connections to the input and output devices, the only requirement being that an operator has key in a different set of instruction. The result is a flexible system which can be used to control systems which vary quite widely in their nature and complexity.

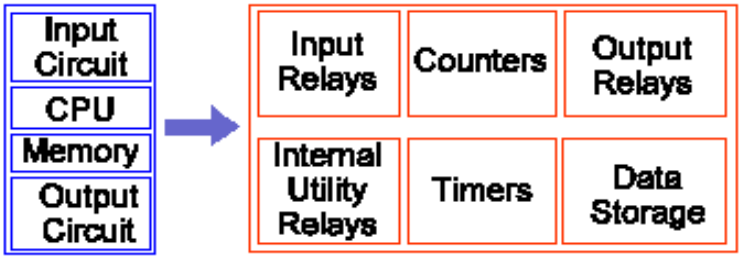

Fig 1.INTERNAL BLOCK DIAGRAM OF PLC

III. SCADA FOR MONITORING

As implemented, RTUs and PLCs serve overlapping application niches and share some design details. To combat industry confusion, the discussion that follows provides a background of RTU and PLC units, and compares the various technical aspects for specifying the units including environmental ruggedness, modularity and scalability, and CPU performance. With remote applications for PLCs and RTUs continuing to expand, the discussion also helps the reader understand crucial remote system communication requirements including store and forward, report by exception, support for multiple protocols, and two-way communication with acknowledgements.

Many industrial and infrastructure-scale enterprises depend on equipment located at multiple sites dispersed over a large geographical area. A vast majority of large infrastructure and industrial-scale ventures use Supervisory Control and Data Acquisition (SCADA) systems.

SCADA systems provide monitoring, control, and automation functions that allow the enterprise to improve operational reliability, reduce costs through eased work force requirements, enhance overall Quality of Service (QoS), or meet expected QoS or other key performance factors as well as boost employee and customer safety.

IV. BLOCK DIAGRAM

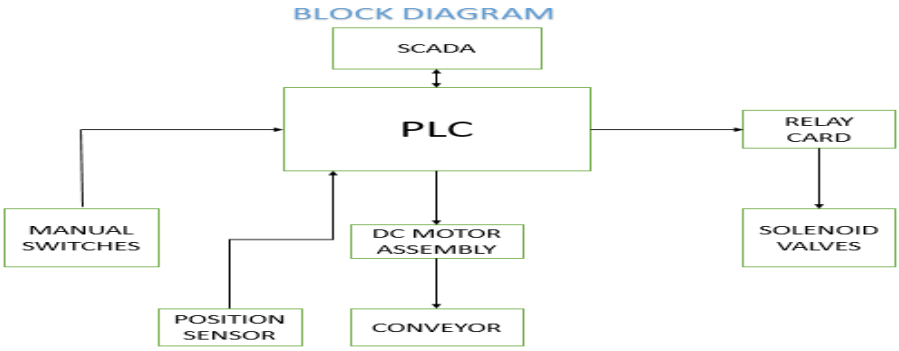

Fig: 2 BLOCK DIAGRAM

This deals with the key components used in settling up the complete process and thus explains the use and working of each component. The block diagram of the experimental set up is illustrated. The following configurations can be obtained from the block diagram

The digital computer is used as an interface between PLC and SCADA. The PLC is a microprocessor based system controller used to sense, activate and control industrial equipments and thus incorporate a number of input output/modules which allows electrical system to be interfaced. SCADA is a centralized system used to supervise a complete process and basically consists of data accessing features and controlling processes remotely. The communication medium used is RS-232 cable. The output of the PLC is given to the DC motor which in turn drives the conveyor assembly. An inductive sensor (position sensors) is an electronic proximity sensors used to detect metallic objects without touching them. Proximity Sensors are available in two types namely;

1) Inductive sensors

2) Capacitive Sensors

We are using Inductive sensors since they are cheaper and allow detection of metal objects as required.

The solenoid valve is a normally closed direct acting valve used to pour the liquid in the container whenever it gets a signal from the proximity sensor.

Fig. 3 A DELTA 8/6PLC

V. METHODOLOGY

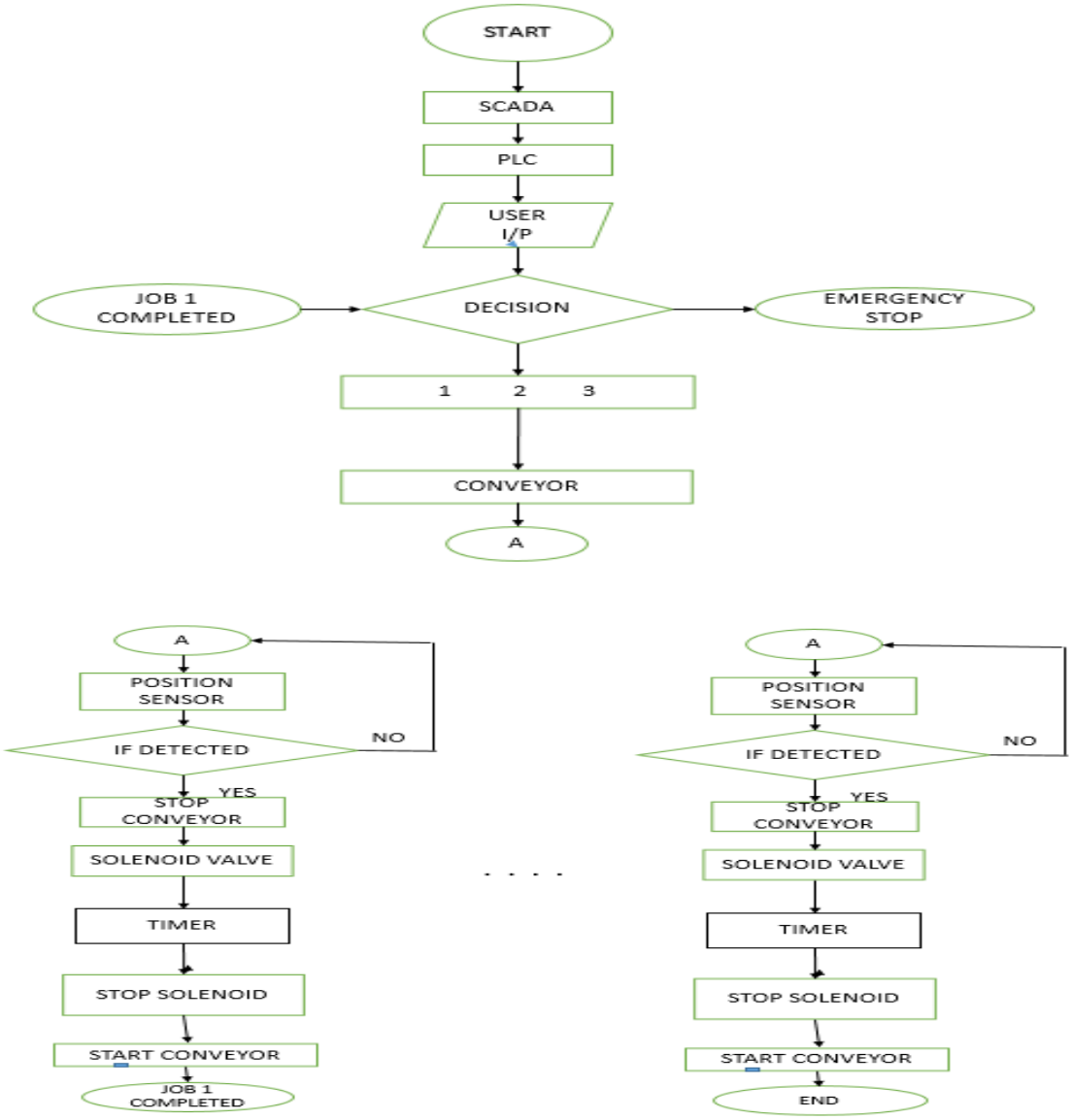

Fig. 4 FLOWCHART

We are going to mix a maximum of 3 chemicals .The chemicals needed are user inputted through SCADA. We can select any combination of three chemicals.

To start the process of optimized mixing, (incase all three are selected) a container is placed on the moving conveyor belt. When the container reaches the first position, sensor 1 senses the container, it gives a high output. This high bit is given to the PLC. The PLC in turn gives a signal to the relays to stop the dc motor and open the solenoid valve. The solenoid is open for a specific time .After the time has elapsed the solenoid valve stops and the dc motor starts. When the container reaches the second position, sensor 2 senses the container, it also gives a high output to the PLC. The PLC instructs the relay to stop the motor. The high output bit of sensor 2 is also given to the timer for the solenoid valve. The timer used is TON. It counts for a predefined value of time (5 sec). It gives two outputs, Enable output and done output. The Enable output remains high while the timer is counting and the output goes high after the timer has finished counting. The Enable output of TON is given to the solenoid valve, and so the solenoid valve is open for the predefined value of time (5 sec). The Done output bit is used to turn ON the motor again in the running condition. The PLC is programmed with a ladder diagram.

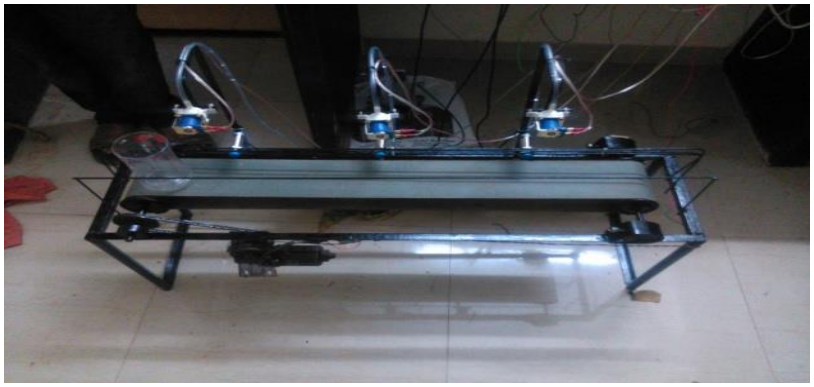

Fig. 5 PROJECT MODEL

VI. SPECIFICATIONS

DC MOTOR 12V 2A

SOLENOID VALVE 24V 400mA

INDUCTIVE SENSOR 24V 400mA

PUMP MOTOR 12V 600mA

VII. APPLICATIONS OF PLC

Manufacturing Industry

- Lead acid battery plant, complete manufacturing system
- Extruder factory, silo feeding control system Travel Industry
- Escalator operation, monitored safety control system
- Lift operation, monitored safety control system Aerospace
- Water tank quenching system

Printing Industry

- Offset web press print register control system
- Multistage screen washing system

Food Industry

- Filling machine control system

- Main factory feed water pump duty changeover system

Textile Industry

- Industrial batch washing machine control system
- Closed loop textile shrinkage system

Hospitals

- Coal fired boiler fan change-over system

Film Industry

- Servo axis controlled camera positioning system

Plastics Industry

- Extruder factory, silo feeding control system
- Injection moulding control system

VIII. CONCLUSION

The automation can be on the same machine level on a production line, or in a whole department where the workers tasks is monitoring, inspection, and maintenance. This paper presented the automation of Optimized Preparations Of Chemical Mixtures in a production line of which this process is done manually in different companies. PLC today are advancing in terms of applicability and capability. The experimental prototype uses a programmable logic controller specifically the DELTA PLC and the electro-mechanical devices. The system works during normal operation and greatly improved the automation processes with the use of the PLC ladder diagram. The wiring and installation procedure are also improved because the PLC input and output devices are assigned with specific addresses, and thus further simplifies troubleshooting. Cost reduction mainly on the man-power or personnel cost is achieved in this paper. The utilization also of the other PLC brands and models may be suggested depending on the need and specifications of different processes. Some PLC is now web based while some already have the file transfer protocol (FTP) integrated and email applications as well. These controllers can also be used to mechanize the packaging and material handling, giving a hundred percent fully automated system without any human intervention.

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