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Real Time Implementation of Scada System for Ratio Control Based Filling Plant

Kumar Dhiraj[1], F. Ansari[2], Rajiv Kumar[3] & Kumari Namrata[4]

[1,3]BRCM College of Engg. & Tech., Bahal, Haryana, India

[2]BIT Sindri, Dhanbad, Jharkhand, India

[4]NIT, Jamshedpur, Jharkhand, India

(E-mail :[1]kumardhiraj9@gmail.com)

Abstract: The objective of this paper is to design, develop and testing of the "Real time implementation of SCADA system for ratio control based bottle filling plant". 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. In this work, a prototype has been designed. The system sequence of operation is being designed by ladder diagram and programming of this project is implemented by using Proficy Machine Edition software; special attention has been dedicated to SCADA, which is being used to get the required configuration screens. Simulation of the system is expressed on the computer screens using serial communication port between PLC and PC, and parallel port between PLC and system hardware components is used.

Keywords: PLC; SCADA; Conveyor; PC

1. INTRODUCTION

This paper implements the filling operation of ratio control based fluid bottle plant. It includes about how PLC & SCADA systems are implemented in the industry. So, it includes PLC & SCADA components and protocols of the system. And it also includes how to interface PC to the processing plant. PLC & SCADA software is mainly implemented for the control and monitoring between processing hardware and computer. It applies interfacing sever protocol when needed between the SCADA software and the hardware process. Filling process model has been designed with the help of hardware devices. It uses dc gear motor drivers, sensing devices, Limit switch, Programmable Logic Controller (PLC) device and serial port communication.

The PLC(s) handle the direct control of the technological process whereas the central dispatching unit user interface- HMI, the changes in the process unit operation is implemented by the PC station. It will reduce the operating costs and the decrease of the technological fluid losses in the process.

So, a typical SCADA control system consists of one or more remote terminal units (RTU or PLCs) connected to a variety of sensors and actuators, and relaying information to a master station. Figure 1 shows the control system of ratio control based filling process using SCADA. According to SCADA control system, the hardware components of the filling process are implemented and interfaced between the PLC and PC.

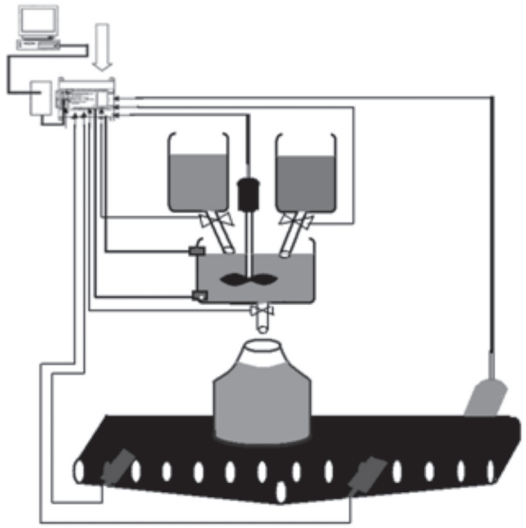


Figure 1: Control System of Ratio Control Based Filling Process Using SCADA

2. METHODOLOGY OF HARDWARE DESIGN

Before selecting PLC modules, analyze the controlled object to count out I/O points. The current requirement and 20% to 30% margins should be considered, allowing the system to expand. Based on the analysis of control task, the system chose Ge Fanuc IC-200 series of products. This series PLC could meet requirements of the medium-performance control system and adopt modular structure. Many different modules can be combined together and users should select

appropriate modules according to the actual need. PLC modules selected are shown in Table 1.

Table 1
Hardware of PLC

Module	*Type*
CPU	IC200CPU001
Ethernet Processor	IC200EBI001
Digital Input Module	IC200MDL640F
Digital Output Module	IC200MDL740E
Power Supply	IC200PWR101E

The Ethernet communication module IC200EBI001 provides a standard RS232 interface, one of the functions is to connect the PLC to Industrial Ethernet to communicate with computers, and the other function is to provide redundant backup link for master CPU and reserve CPU to realize redundant communication between the PLC and PC.

Conveyor provides a continually moving surface that is designed to move bottle from one location to another. The dimension of the conveyor is approximately 15 inch of length and five inch of width. It consists of motor, trek, gear and other electronic circuit. Motor is the main part to make the conveyor belt moves perfectly. In this work gear DC motor is used because it can provide the high starting torque.

IR sensor provides the system with ability to detect the presence of object position. If an object is present the signal will be generated by the sensor and provided to the PLC. Omron limit switches have been used to control the low level and high level in the main tank to avoid the wasting of fluid and safety of the process unit.

2.1. Connection of Electrically Operated Process

As shown in Figure 2 is the connection of electrically operated process. The feedback of electrically operated process includes seven digital signals which are remote mode indicating contact, auto start, auto stop, emergency stop, bottle filling sensor, bottle pick up sensor, main tank low level indicator and main tank high level indicator. When the valve is in the remote control mode, digital outputs of PLC drive the relays and then control the valves. Seven Output control signals include conveyor, tank 1st valve, tank 2nd valve, tank 3rd (main) valve, mixer motor; process start indicator and process stop indicator signals.

3. DEVELOPMENT OF PROGRAMMING

Control system is a collection of electronic devices and equipment which are in place to ensure the stability, accuracy and smooth transition of a process or a manufacturing activity. Every single component in a control system plays an important role regardless of size.

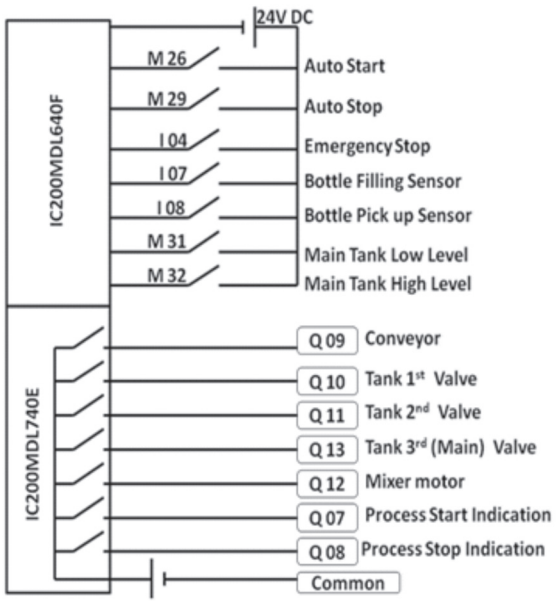
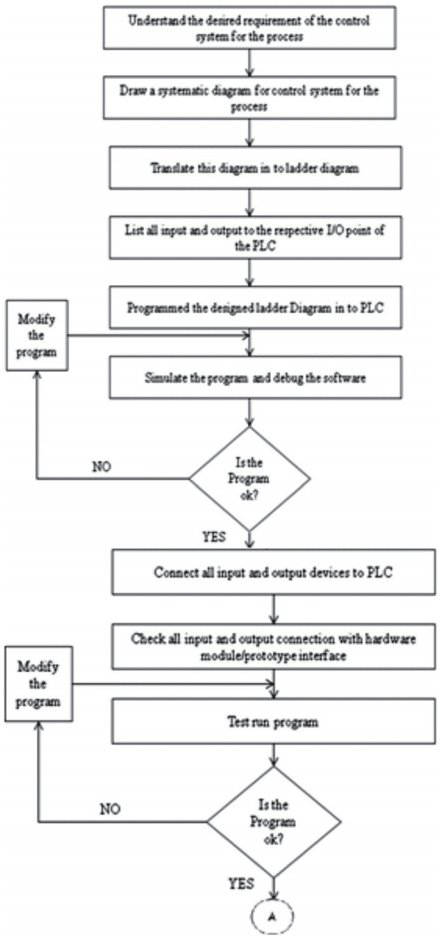


Figure 2: Connection of Electrically Operated Process

Before programming, the concept of controlling a control system is introduce, which is the systematic approach of control system design using a PLC. The operation procedure of the system approach is shown in Figure 3.



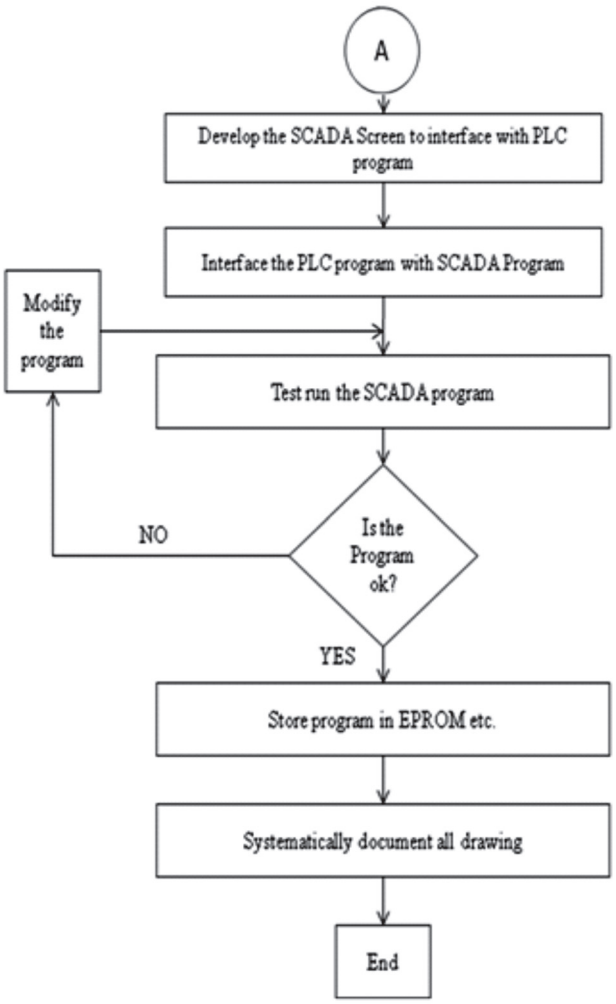


Figure 3: A Systematic Approach to Programmable Control Design Flow Chart

A ladder diagram is produced according to the Process Flow diagram of the system and based on the system operation and condition. Figure 4 shows the ladder diagram of the system. The system in the ladder diagram form will be programmed into PLC. Once the programs have been downloaded into PLC, it can be monitored in the Diagram Workspace during execution. Furthermore, the Proficy machine Edition provides on-line editing functions during execution. Note that the on-line editing is not possible in Run mode. All activities occur can be observed using the Proficy Machine Edition Programmer.

A SCADA screen is design as per the requirement of the ladder logic program and for design of SCADA screen we have to assign the same address values of inputs and outputs to interface the PLC ladder logic program with SCADA. Furthermore it would be clearly understood by the operator who is sitting in the control room to control the process remotely. Figure 5 shows the initial control SCADA screen of the process and Figure 6 shows the initial main screen of the process.

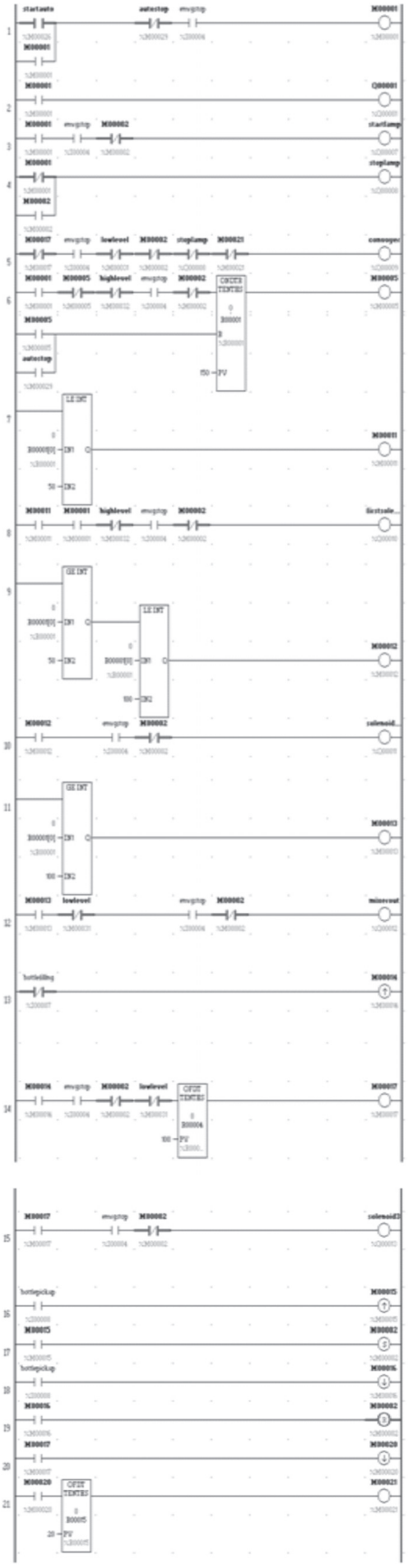


Figure 4: Ladder Diagram

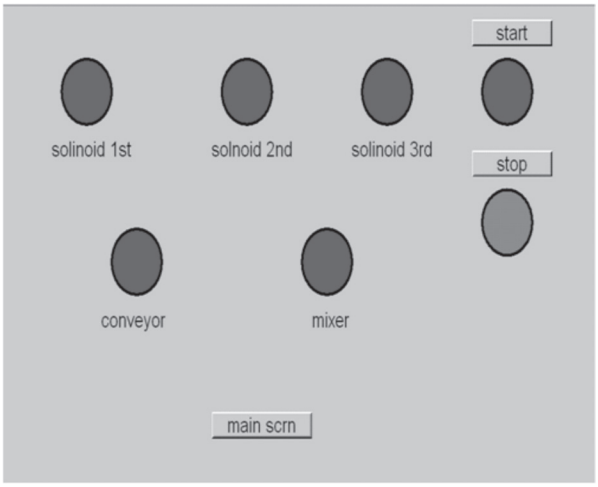


Figure 5: Initial Control SCADA Screen

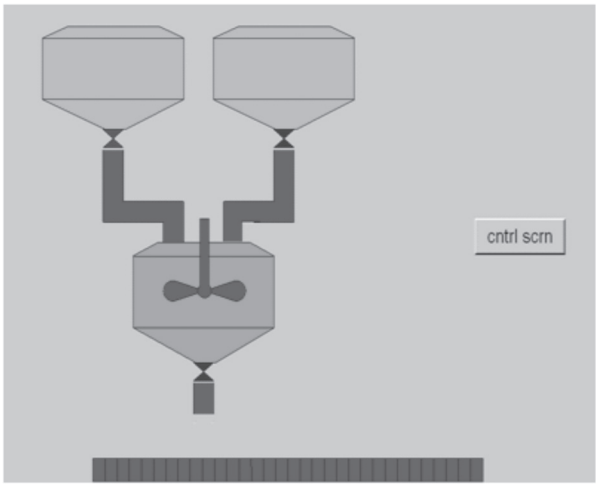


Figure 6: Initial Main SCADA Screen

4. IMPLEMENTATION AND TESTING

The prototype was mainly built by combining the mechanical design and the electrical designs. The bottle will move on the conveyor belt. The conveyor will be stopped automatically after the infrared sensor detects the presence of the bottle below the control valve of main tank. There are two liquids in two different tanks (says tank 1 and tank 2), both have control valves (solenoid valve1 and 2 respectively) in the bottom of tanks through which these two different liquids goes to the main tank (say tank 3). The ratio of two different liquids will decided as per the required mixed liquid that we needed in the bottle. There is a stirrer motor is also fitted to mix these two liquids of definite amount in the main tank. The design of the work with wiring connection is shown in Figure 7.

When bottle is filled the conveyor will start so that bottle reach to the destination from where pick up sensor (infra red) will sense the bottle position and immediately will stop

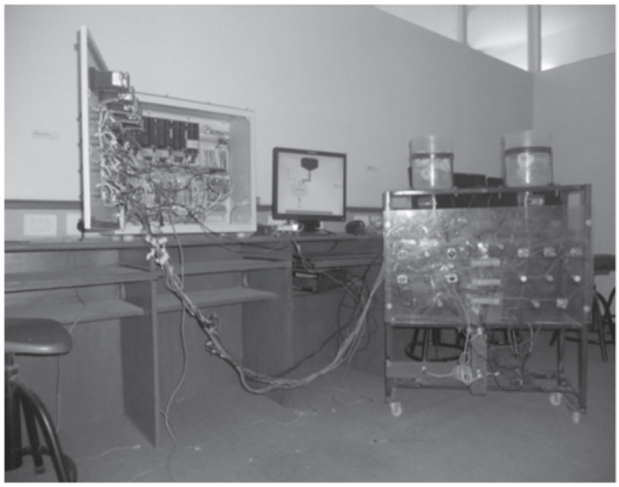


Figure 7 : Design of Project with Wiring Connection

all the process till the bottle is not picked up and if someone pick up the bottle then the same process will start again. On the third tank a high level and a low level indicator are provided to protect the system and to avoid the overflow in main tank. For the safety point of view there is an emergency stop switch is also provided on the control panel of the machine so that the operator can stop the process manually if there is any problem in the process which is going on.

5. CONCLUSION

The theory and concept of the Real Time Implementation of SCADA System for Ration Control Based Filling Plant is based on the control system. In electrical design, the features and functions of the electrical components are required to determine the system requirement. Furthermore, the theoretical of the wiring system is required for connecting the inputs and outputs devices to PLC. In programming design, understandings of the desired control system and how to use the Ladder Diagram to translate the machine sequence of operation are the most important parts, because it has direct effect on the system performance. The main aim in this process is to apply PLC and SCADA to design Real Time Implementation of SCADA System for Ration Control Based Filling Plant and all objectives in this project work were successfully done as planned. Finally, the basis control system and logic design apply in this project can be used as a references to design other applications of automation system, and also can be used as a teaching material for the Industrial Control subject.

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