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Development & Implementation of Mixing Unit using PLC

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***Abstract*—Automation plays an increasingly important role in the world economy. It uses control systems and information technologies to reduce the human effort in the field of industries. In our project we are developing a system that uses automation in the paint mixing. The paint will be produced by means of mixing different colors according to a fixed proportion. The entire system will be continuously monitored by Supervisory Control AndData Acquisition system and it is controlled by Programmable Logic Controller. The process has mainly 3 steps including paint mixing, transportation and packing section. Initially the paint will be formed based on our required proportion of colors and is then transported to the packing section via conveyor belt. Finally it is packed and sealed in the packing section. This system is properly controlled using PLC and the user can enter the required proportion of color via SCADA.**

***Index Terms*— Ratio control, PLC-programmable logic controller, SCADA-supervisory control and data acquisition, Paint mixing, Packing, Online tuning.**

I. INTRODUCTION

The field of automation has had a notable impact in a wide range of industries beyond manufacturing. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy. One of the important applications of automation is in mixing process where definite ratio of colors has to be mixed.

For these kinds of applications the trend is moving away from the individual device or machine toward continuous automation solutions. Totally Integrated Automation puts this continuity into consistent practice. Totally Integrated Automation covers the complete production line, fromreceipt of goods, the production process, filling and packaging, to shipment of goods. Our project is also an application of automation wherein we have developed a paint mixing, transportation and capping system .The various processes are controlled using a PLC (Programmable Logic Controller) and is monitored using SCADA (Supervisory Control And Data Acquisition) software.

The required proportion of different colours is given as an input to the PLC via the SCADA software. Based on the given requirements the PLC will be controlling the flow sensor attached to the dc solenoidal valve so that the ratio of each paint is controlled and the mixing process is done.The process of mixing will be already

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programmed in the PLC. After the mixing process the result will be transported to another location. The transportation will be possible using the conveyor belt and DC servo motors. The colors required for the paint mixing can be selected through online based on the customer requirements. These features can be available to the designer with the help of SCADA software. The mixing will be done in a bottle or small buckets. This filled bucket will be finally given to the packing section. In the packing section the bucket or the bottle will be capped automatically. The filling, transportation and capping process will be automatically done using the PLC programming. The final sealed product will be given to the customer for their usage.

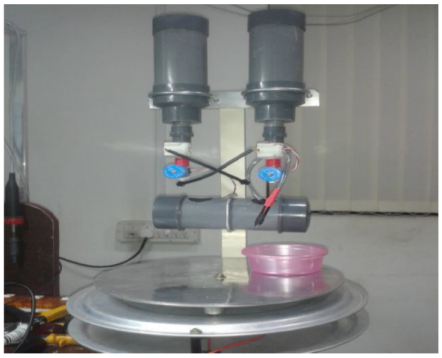

Figure1. Paint mixing system

II. Literature Survey

T.Kalaiselvi, Aakanksha.R,Dhanya.S , R.Praveena [1],"PLC Based Automatic Bottle Filling and Capping System With User Defined Volume Selection", this system does the filling and capping of bottles simultaneously. Both the process takes places at simultaneous manner .Bottles are kept in position in a carton over a conveyor belt; they are sensed to detect their presence. IR sensors are used for sensing the bottles. Depending on the output of the sensor the corresponding pumps switch on and filling operation takes place. If the particular bottle is not present then the pump in that position is switched off, thereby avoiding wastage of the liquid.filling operation is accompanied with a user-defined volume selection menu which enables the user to choose the volume of liquid to be filled. The filling process is done based on timing. Depending on the preset value of the timer the pump is switched on for that particular period of time and the filling is done. The entire filling and capping operation is controlled by PLC and is monitored using SCADA (Supervisory Control and Data Acquisition).

Dr.D.V.PushpaLatha [2] "Simulation of PLC based Smart Street Lighting Control using LDR", Here it is an approach to accomplish the demand for flexible public lighting systemsusing a Programmable Logic controller (PLC).In the current street light system the light will be switched on at evenings and will be switched off at in the morning. The consequence is that alarge amount of power is wasted meaninglessly. This system ensures an useful way of operating the street light based on intensity of light using LDR and PLC. It is done based on seasonal variations. The PLC is programmed based on our requirement including timing and sequencing. By this way a large amount of energy savings can be achieved.

Dhanojmohan,Rathikarani,Gopukumar [3],"Automation in ration shop using PLC ,proposed a methodology for ration shop automation using embedded PLC. Further the updating to the government database about the stock available and the customer details were not carried out. Only the ration commodities will be delivered to the customers according to their allotted products, the delivering of the process and the entire control action will be done by PLC.

III. An Overview of PLC

PLC or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. PLCs are designed for multiple analogue and digital inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-

backed-up or non-volatile memory. A PLC is an example of a "hard" real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result. Before the PLC, control, sequencing, and safety interlock logic for manufacturing automobiles was mainly composed of relays, cam timers, drum sequencers, and dedicated closed-loop controllers. Since these could number in the hundreds or even thousands, the process for updating such facilities for the yearly model change-over was very time consuming and expensive, as electricians needed to individually rewire the relays to change their operational characteristics.

Digital computers, being general-purpose programmable devices, were soon applied to control of industrial processes. Early computers required specialist programmers, and stringent operating environmental control for temperature, cleanliness, and power quality. Using a general-purpose computer for process control required protecting the computer from the plant floor conditions. An industrial control computer would have several attributes: it would tolerate the shop-floor environment, it would support discrete (bit-form) input and output in an easily extensible manner, it would not require years of training to use, and it would permit its operation to be monitored. The response time of any computer system must be fast enough to be useful for control; the required speed varying according to the nature of the process.[1] Since many industrial processes have timescales easily addressed by millisecond response times, modern (fast, small, reliable) electronics greatly facilitate building reliable controllers, especially because performance can be traded off for reliability.

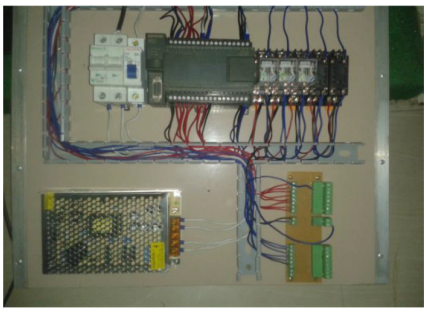

Figure 2. Programmable Logic Controller

IV. Supervisory Control and Data Acquisition

SCADA (supervisory control and data acquisition) is an industrial control system at the core of many modern industries such as manufacturing, energy, water, power, transportation and many more. SCADA systems deploy multiple technologies that allow organizations to monitor, gather, and process data as well as send commands to those points that are transmitting data. Virtually anywhere you look in today's world, you will find some version of a SCADA system running, whether it's at your local supermarket, refinery, waste water treatment plant, or even your own home.SCADA systems range from simple configurations to large, complex projects. Most SCADA systems utilize HMI (human-machine interface) software that allows users to interact with and control the machines and devices that the HMI is connected to such as valves, pumps, motors, and much more.

SCADA software receives its information from RTUs (remote terminal units) or PLCs (programmable logic controllers) which can receive their information from sensors or manually inputted values. From here, the data can be used to effectively monitor, collect and analyze data, which can potentially reduce waste and improve efficiency resulting in savings of both time and money. Numerous case studies have been published highlighting the benefits and savings of using a modern SCADA software solution such as Ignition.

V. System Working

The main blocks of the system are sensors, power supply, filling mechanism, transportation, conveyor belt, capping system. The sensor will be mostly an object sensor which wills checks the presence of bottles or buckets. After checking the presence of the bottles the required amount of color proportion will be given to the PLC through the SCADA. The color selected will be mixed to obtain paint by means of the PLC programming. The paint mixing will be done using solenoidvalves. The obtain paint will be given to the capping section through conveyor belts. The conveyor belt will be operated by means of DC servo motors.

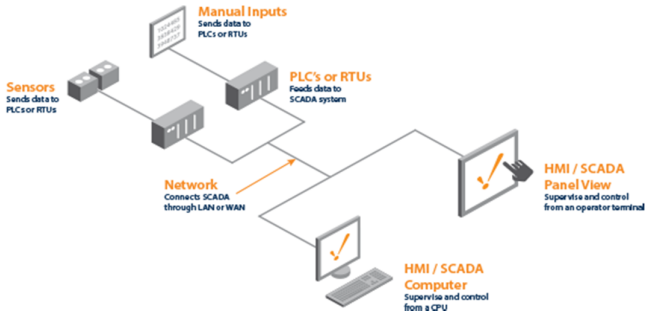

Figure 3 . SCADA system

The speed of the motor can be also controlled using PLC. The different color combination for the paint will be selected through internet as per the interest of the customer. The finally mixed paint will be given to capping section where proper capes will be filled to the bottles/buckets. The capping section will be an another mechanical part like the filling part. Both these part will be synchronously executed by means of PLC and SCADA. The final product of our system will be a sealed paint as per the customer choice. We are actually decided to mix two colors to obtain a final product and also we are providing the ratio of colors. The PLC we are using in this system is SIEMENS S71200 model which one is actually suits for our requirement. The PLC is having 24 digital inputs and 10 digital outputs. The PLC can be well programmed to obtain a perfect result.

Figure 4. Proposed Methodology

A. Hardware details

The hardware we have developed is actually a high speed system which includes several seconds to complete the entire working. The initial filling of the bottles takes about 3-5 sec. After the filling section the bottle will be given to the packing section and packing will be completed within 8 sec. The PLC we have used in our system is siemen's s71200 model which has 14 digital inputs and 10 digital outputs and 1 analog I/O. here we have also using solenoid valves (1/2 inch), flow sensor and proximity sensors for measuring the flow rate and detecting the presence of the bottle to be filled.

VI. Advantages and Disadvantages

High accuracy than hand mixing. Low labour cost. Required color proportion can be obtained. Human effort can be minimized. The proposed system can be used for mixing of paint in required proportion .They find wide applications in automobile industry, architectural designing etc.. They can be used for enhancing the overall appearance .In the coming years they can be used for the mass production of custom paints.

VII. Conclusion

The system we developed will be an automatic paint mixing unit which will reduce the human effort, it only require human effort at the beginning for providing the base colors only. The manual work of mixing will generate enormous errors which will affect the entire process. Mixing paints manually in critical ratios is a tedious task which may causes error the desired result may not occur. In order to reduce this difficulty the

system is made fully automatic by means of using PLC. The system also pack the mixed paint in tins and placing the top above the tin.

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