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Automatic Colour Mixing Machine using PLC

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***Abstract*—In this color mixing machine we use three tanks which are of Red, Blue and Yellow. The three tanks consist of level sensor and fitted with hydraulic line. The hydraulic line consist of solenoid valve.The tank consists of color Steiner of Red, Blue and Yellow. The Steiner flows from hydraulic line into the mixing tank through solenoid valve. The solenoid valve is a digital output device that is connected to the PLC .Their is three solenoid valves connected to three tanks. The white color tint is in which is tank 4 of required proportion (as per order). The weight of the mixing tank is calculated by a weight measuring sensor i.e. load cell. The load cell is an analog type output device.**

***Index Terms*— PLC(programmable logic controller), Solenoid valve, Steiner etc.**

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. With the rapid development in technology, the more focus is on selection of application oriented Controllers and tools. PLC and DCS are the most efficient and widely used tools in industrial automation. Automation is nothing but taking a system or process and making it automatic by eliminating human work as much as possible. With all of the technological advances that have occurred over the years, it is obvious that in many cases automation equipment can make actions happen much faster, more reliably and more consistently than a human can. Industrial Automation is the industry of helping business to automate the systems that produces their goods or services in the most efficient manner possible. Benefits of Industrial Automation are product produced faster, product produced more consistently, products produced more reliably and decreased labour expenses[1][7].

Automation of Process control is the process of recognizing the status of system generates the information according to rules and actuate the control element in order to achieve the control variable to its approximate value. The oldest method in process control was manual control in which human takes all actions and decisions but due to errors in this method; it was followed by hard-wired logic control. Logic gate was one-step advancement in this method. As circuit becomes larger complexity of logic gate goes on increasing so Microcontroller comes into picture followed by PLC programming. Control of field signals is done using these devices as per signals coming from devices and complexity of process.

DRAWBACKS OF CONVENTIONAL SYSTEM

Conventional control system may cause various errors due to the involvement of the humans. In conventional control the data processing, data collection and recording is done with the help of humans. Thus to avoid this we are using a PLC to collect the data, compare it with the standard value and the simplified output is provided to the process. At the same time PLC will generate its output in fraction of time.

PROCESS DESCRIPTION

This colour mixing machine is of corob d200 of Asian paints equipment. This machine is based on microcontroller, and operates 230 VAC. The exact process of this machine is described as follow.

The process of this machine is described as follow; the first step of this machine is filling the Steiner inside the tank situated at top of the machine. The strainer is completely filled inside the tank called as column. Then the next step is to give order as per requirement of customer. The communication between the corob machine and personal computer is done by suitable protocol. The communication between machine and PC is done by machine supported software. In this software the requirement and the quantity of customer is feeded , and as per order given by operator machine works[2][3].

Figure 1: Tanks containing Steiner

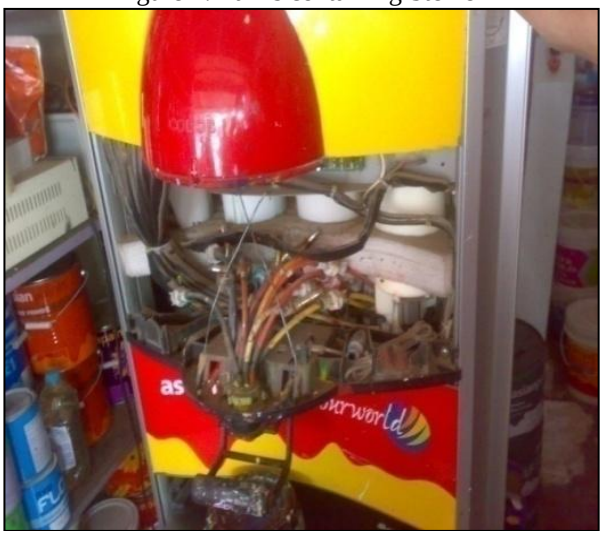

Figure 2: Pipes Assembly with Valve.

The figure 1 and figure 2 shows arrangements of tanks in the corob machine. This tank's consists of different shades of colour. The actual working of tank is described as follows. Through the tanks pipe like arrangement is in fig below. These pipes are connected to valve, these valves are operated from computer then at the end of pipe nozzle is fitted. These nozzles discharge the required amount of Steiner from the tank.

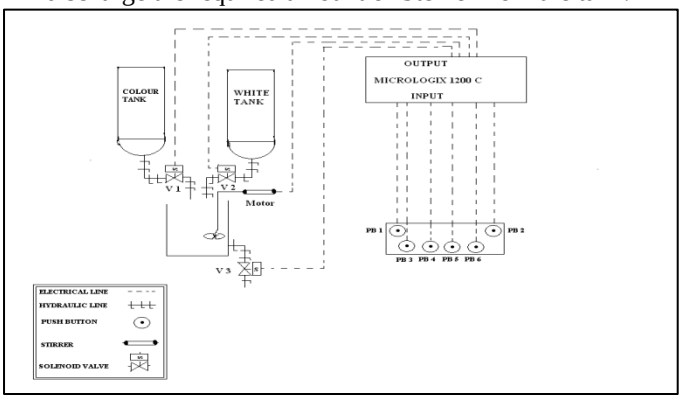

Figure 3: Concept of colour mixing machine.

Then next step is fitting the tint below the nozzle so that the discharge amount of strainer coming from the tank is dip into the tint. Next step is this tint fitted to grinder. The working of grinder is to mix the colour as per required manner. Figure 3 shows Process diagram of colour mixing machine[5].

The first step is fill the source tanks with the help of colour Steiner, Then the tanks are connected through pipes and at the of these pipes solenoid valve are fitted. There are two source tanks and one mixing tank with is taken into in system and as there are two source tanks, there are two solenoid valve as well. The mixing tank is situated below the two source tank and pipes coming from these source tanks is get emerged in to the mixing tank. The mixing tank consists of a stirrer the purpose of this stirrer is mix the colour uniformly present in the mixing tank.

The main block or the brain of the system is Programmable Logic Controller (PLC). It is the controller which controls whole system. The level sensor, solenoid valve, load cell is connected to PLC in input and output module. Whole operation is done with the help of solenoid valve considering time factor of solenoid valve. The opening or closing of solenoid valve is done with help of PLC. We use Ladder as a programming language[2].

SYSTEM DESIGN

The basic design consists of

1. Selected Colour Tank
2. White Colour Tank
3. Collector Tank (Mixing Tank)

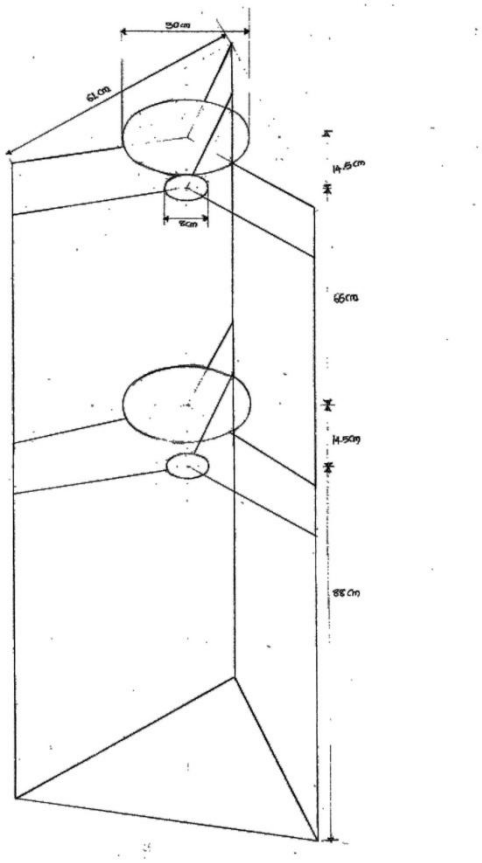

Figure 4: Prototype model with dimensions[7].

Selected Colour Tank: In these tanks different colours are stored like red, blue, yellow etc. This is the primary part where the main colour are stored. These tanks are smaller in size compared to white colour tank and placed near to white colour tank.

White Colour Tank: In these tanks only the white colour is present. This white colour is added with the selected colour to form the required colour shade. This tank is big in size. compared to the other tanks.

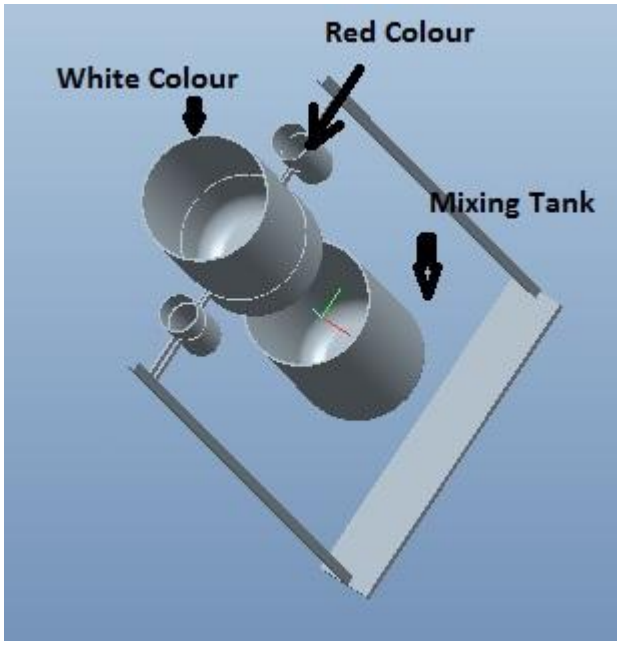

Figure 5: CATIA V-5 3D view of the system[5].

Collector Tank (Mixing Tank): In this part the white colour is mixed with the selected colour. This mixture is then mix with the help of a stirrer as shown in figure 3. This tank is 102.5 cm above the ground level.

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INPUT/OUTPUT ASSIGNMENT

It consists of inputs, outputs of various sections used in the plant there were analog input/output, digital input/ output. Based upon the Process, there are total 06 Digital Input, 04 Digital Output. Table below gives details of I/O used and remains spare from embedded I/O of MicroLogix -1200 PLC.

TABLE 1: DIGITAL INPUT ASSIGNMENT LIST

Add. No	DESCRIPTION	TYPE	TAG NAME
I:0.0/1	Push Button 1 for Litre Selector	DI	PB 1
I:0.0/0	Push Button 2 for Litre Selector	DI	PB 2
I:0.0/2	Push Button 3 for Litre Selector	DI	PB 3
I:0.0/3	Push Button 4 for Litre Selector	DI	PB 4
I:0.0/4	Push Button 5 for Litre Selector	DI	PB 5
I:0.0/5	Push Button 6 for Litre Selector	DI	PB 6

TABLE 2: DIGITAL OUTPUT ASSIGNMENT LIST

Add. No	DESCRIPTION	TYPE	TAG NAME
O:0.0/1	Solenoid Valve For White tint	DO	SVW
O:0.0/0	Solenoid Valve For Colour Steiner	DO	SVC
O:0.0/4	Solenoid Valve For Mixed Colour	DO	SVM
O:0.0/3	Motor used as stirrer	DO	MS

FLOW DIAGRAM FOR TWO LITRE

The process flow diagram is shown in figures below below figures are made by considering the 2 liter mixture.

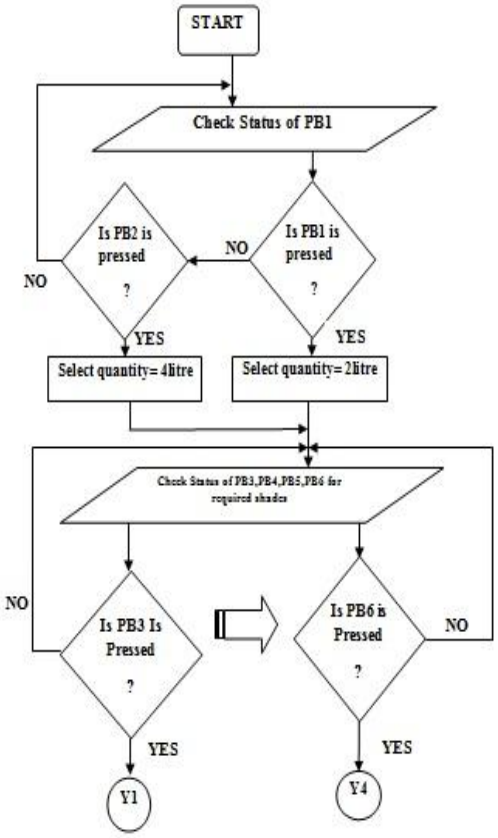
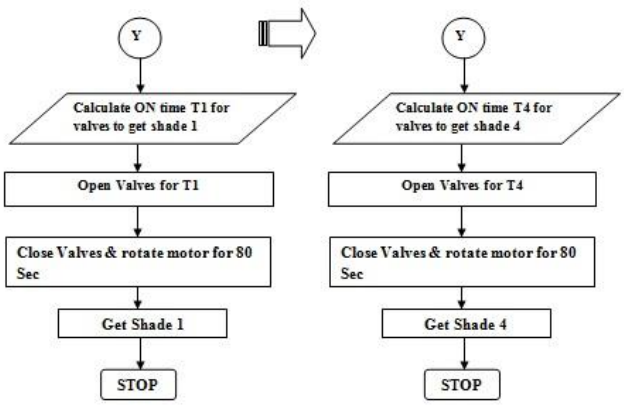


Figure 6(a): Flow diagram



Quantity Selectors	PB1	Push Button for 2 litre
	PB2	Push Button for 4 litre
For all quantity Shade selector	PB3	Push Button for Shade1
	PB4	Push Button for Shade2
	PB5	Push Button for Shade3
	PB6	Push Button for Shade4

Figure 6(b): Flow diagram for two liters.

RESULT

After designing hardware setup and drawing ladder diagram, we have tested the system in totality. We found that system is working as per the sequence of the process. For example, when solenoid valve 1 is open for some time required amount of tint is fall into the mixing tank and after the closing the valve1 automatically solenoid valve 2 is open and small amount of Steiner is fall into the mixing tank after the closing valve 2 automatically motor starts; required amount of mixture is properly mixed into the mixing tank and required colour shade is produced.

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