Research Article

Automated High Speed Color Mixing and Bottle Filling Process using PLC & SCADA
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Abstract:
This system is designed, implemented and developed for “automatic mixing and filling of the liquid into bottles using PLC & SCADA”. The pressure of continuously increase in production volumes is giving force to older systems and this increases maintenance requirements. Manufacturers do face main problems like: higher costs and increased production time. Nowadays, reduction in cost, wastage and production time is the challenges for industries. To reduce water usage, increase efficiency and minimize the production time for beverage industries new technologies are required. In order to systematize a liquid mixing and bottle filling plant and minimize human efforts, Supervisory Control and Data Acquisition System is being used. The SCADA with PLC logic ladder is used for monitoring the plant and helps in reducing the errors caused by humans. Internal storage of instruction for the implementing function such as logic, sequencing, timers, counters and arithmetic to control through digital and analog input output modules of machines can be programmed and monitored by PLC (programmable logic controller). Combination of PLC & SCADA system is used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation. The system for automatic liquid mixing and bottle filling system must contain low power consumption, low project cost, high flexibility and accuracy. At the same time it must convey specific amount of liquid to be filled in bottles for saving the operational time. System must be fully automated and free of human errors with high precision are the major expectations of such systems.

Keywords: PLC, SCADA, Color Mixing & Bottle Filling, Automation

1. INTRODUCTION

The field of automation has a vital impact in a wide range of industries beyond manufacturing. Automation can be defined as the use of control systems and information technologies simultaneously to reduce the human workforce in the production of goods and services. Basic requirements for manufacturing and production industries are high degree of flexibility and safety with low cost which can be achievable through automation and supervisory monitoring. One of the important applications of automation is in the color mixing industries where production of oil paints, water colors, ink, etc. take place where a particular amount of different liquids having different colors has to be mixed and filled continuously. For these kinds of applications, continuous automation systems are working in place of group of humans or individual machine. Complete production line from reception to goods, the production process, mixing, filling and packaging to shipment for goods can be totally covered by Integrated Automation. Our project also contains an application of automation in liquid color mixing and filling into bottles. PLC & SCADA controls the various processes.

2. METHODOLOGY

This project is completely automated. All processes will be controlled by PLC and monitored by SCADA. All the programming is kept through PLC while visuals are kept through SCADA. Utilization of a start/stop control button to the system is required. When we on the switch then valve of first liquid color vessel will be open. Like this, all colors are to be kept in a major tank. All valves are controlled by proximity sensors. After accumulation of all required colors in a major tank where mixer setup with heater is there, mixing process will be started and controlled by timer. A conveyor belt setup beneath the tank will keep the empty bottles upon it which are to be filled which will be appended with the motor. After getting the signal from timer for mixing confirmation, motor will go to switch on then conveyor will start moving. At that point when bottle move under the tank opening then another sensor will sense the bottle and the valve will be opened for the particular time that is set in the programming for that amount of the liquid filled in to the bottle. The position of the valve keeps impact on flow rate of the valve. The filling operation depends on sensing and preset value of timers and which is user characterized through which user can fill and pack the volume of fluid to be filled.
3. IMPLEMENTATION

This section gives the brief description about elements in this project and complete process in the system.

A. BLOCK DIAGRAM

The basic diagram of the process is given as follows

B. INPUTS

The input module includes the proximity & position sensors whose output is given as an input to the PLC and start/stop button. Three limit switches are used to detect the bottles position over the conveyor. One push button to start the cycle and push button to stop the cycle are there.

C. OUTPUTS

The various output devices used are A C synchronous motor, solenoid valve. These are connected to the output module. The conveyor is run by a synchronous motor in forward direction. The filling process is controlled by one solenoid valve and are connected to the overhead tank.

D. PLC & SCADA

PLC is a programmable hardware device which has its separate input and output modules to connect input & output devices to it which are going to control through it and SCADA is a kind of software which gives the visual monitoring facility to the system.

4. RESULTS ANALYSIS

Automatic liquid mixing and bottle filling system must have low power consumption, low project cost, flexibility and high reliability. At the same time it should provide particular amount of liquid to be mixed and filled in bottles for saving the operational time and cost. The major assumption from such system is the system should be fully automated i.e. system should be capable in mixing and filling the bottles according to the user's requirement by the help of sensors, timers, programmable logics. It should be capable to operate with continuous manner. The system should be flexible not only for different liquid mixing but also for the filling of different size of bottles. The system should be efficient to monitor the parameters such as temperature, liquid level, quantity, presence of bottle, speed of the system etc.


**Table.1. Result Analysis**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Acquired Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>30% More Efficient (w. r. t. Proposed Method)</td>
</tr>
<tr>
<td>Time</td>
<td>1.5 Sec Per Bottle</td>
</tr>
<tr>
<td>Speed of System</td>
<td>40 BPM</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>10 KW</td>
</tr>
<tr>
<td>I/O device used</td>
<td>Totally 10 nos.</td>
</tr>
</tbody>
</table>

**5. CONCLUSION**

The system has a simple structure and reliable operation. Logical programming for this system is flexible and easy too. The system is controlled by PLC logic and monitored by SCADA. This automation technique can control the continuous colour mixing and bottle filling process. This type of automation is the major boon of the production industries and with the help of automation many things can be controlled inside a farm or industry to produce goods as per the required demands with less cost and high efficiency and accuracy. This technique can also be used for different purposes with some advancements in it. All the system and process can be started and stopped through SCADA screen that is effectively able to avoid unnecessary wastage of liquid and other resources. The system is useful in manufacturing industries like beverage, water colors, paint, ink, mineral water and food industries.

**6. REFERENCES**


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