PLC BASED AUTOMATED MIXING SYSTEM IN A TANK

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Keywords:

PLC (Programmable Logic Controller), Automated Mixing, Solenoid Valves, Agitator Motor, Level Sensors, Ladder Logic, Liquid Handling System.

Introduction:

PLC-Based Automated Mixing System in a Tank automates the mixing of two different liquids from separate tanks, using controlled actions to ensure an efficient and accurate mixing process. The Delta PLC model DVP14SS211R uses a 24V DC power supply to operate. The operation in filling, mixing, as well as draining stages is carried out fully automatically, very ideal for applications that do need to have precise liquid handling

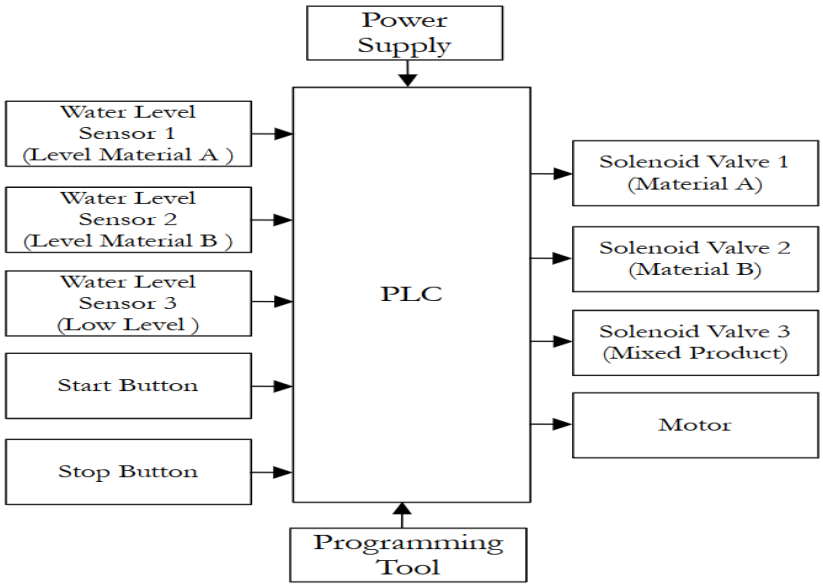

Figure 1: Block Diagram of PLC Based Automated Mixing System in a Tank

efficiency such as manufacture chemical and food processing. The PLC model can be programmed through the use of WPL Soft thus offering efficient design and the development of ladder logic diagrams. The system begins by filling the tank through solenoid valves, which regulate each liquid's flow. The PLC then activates the mixing motor to mix the liquids comprehensively for a given period of time. Mixing is carried out with great precision. Customization of the time allows mixing to be done properly for different operational needs, ensuring that the mixture is always consistent. The entire process is monitored by confirming the presence of liquids and the completion of mixing, making it safer and more efficient with the PLC. Once mixing has been done, the PLC will then trigger the outlet valve of the tank to drain. This project shows the contribution of automation in industrial setup as it demonstrates how PLC like Delta DVP14SS211R improves consistency, reliability, and control in liquid mixing and handling applications in industrial fields.

Objectives:

1. To design and implement an automated system for mixing two liquids using the Delta PLC DVP14SS211R, controlling the filling, mixing, and discharge processes.
2. To integrate sensors, valves, and a motor for accurate level detection, efficient liquid flow control, and uniform mixing.
3. To achieve precise and consistent mixing, reducing manual intervention and improving process reliability in industrial applications.
4. To enhance operational efficiency through programmable control and real-time response to sensor inputs.

Methodology:

The methodology involved designing and implementing an automated mixing system using the Delta PLC DVP14SS211R. The project began with identifying system requirements and selecting key components such as solenoid valves, level sensors, and a universal agitator motor. A mixing tank was used as the main unit where the liquids would be combined and processed. The PLC was programmed using WPL Soft software, where ladder logic diagrams were created to control the sequence of operations. Inlet solenoid valves were connected to two separate tanks and were

controlled by the PLC to allow two different liquids to flow into the mixing tank. Level sensors were installed at the lower and upper levels of the tank to detect the presence and amount of liquid. These sensors provided real-time feedback to the PLC, ensuring precise filling and preventing overflows or underfills. Once the liquid levels reached the set point, the PLC triggered the agitator motor to mix the contents for a fixed duration. Timers were used in the PLC program to control the mixing time and maintain uniformity. After the mixing process was completed, the PLC activated the outlet valve to drain the mixed liquid from the tank. The entire system was assembled according to the electrical design and tested for functionality. Each component was verified individually, and adjustments were made to ensure proper coordination between sensor input and actuator output. Manual switches were also included for safety and emergency control. The system was optimized through repeated testing and fine-tuning of parameters, resulting in an efficient, accurate, and fully automated liquid mixing setup suitable for industrial applications.

Result and Conclusion:

The PLC-Based Automated Mixing System in a Tank worked successfully as planned. The Delta PLC DVP14SS211R controlled the entire process, including filling, mixing, and draining of two different liquids. Level sensors helped in detecting the correct amount of liquid, ensuring accurate filling every time. The agitator motor mixed the liquids for a set time, and the mixture was consistent in each test. The system ran smoothly and repeated the process correctly without manual help. It also handled start-stop operations well and responded safely during testing. The ladder logic program in WPL Soft was easy to modify for different requirements. The system saved time, reduced human effort, and improved accuracy. It is compact and suitable for small-scale industries. The system is safe, reliable, and efficient. It can be used in food, chemical, and beverage industries. The project proved that automation using PLC improves quality and speed. The design can also be upgraded by adding SCADA and HMI in the future. The system offers flexibility to adjust mixing time and sequence based on specific needs. Testing showed no major faults, and the components performed as expected under various conditions. The wiring and layout followed proper safety standards for industrial applications. The results confirmed that the process can

be scaled for larger operations. This project highlights the practical use of PLC in automating real-world industrial systems efficiently.

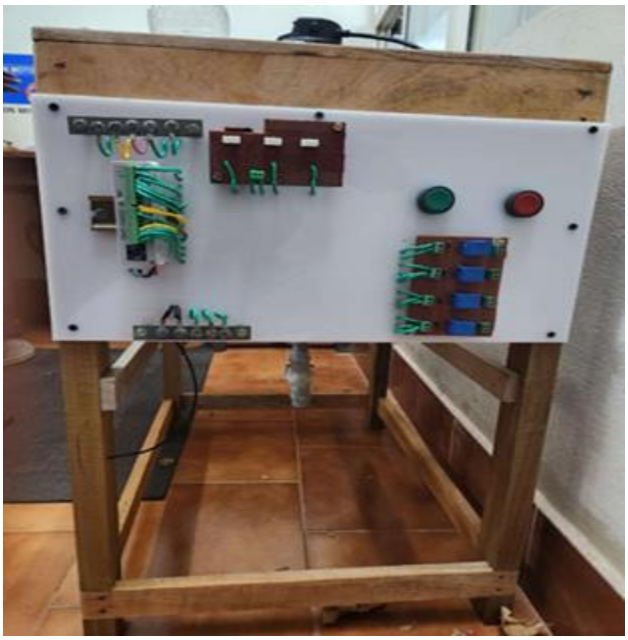

Figure 2: Hardware setup of PLC Based Automated Mixing System in a Tank

Project Outcome & Industry Relevance:

The PLC-Based Automated Mixing System in a Tank successfully showed how automation can help in mixing liquids more accurately and efficiently. Using the Delta PLC, the system controlled the filling, mixing, and draining processes with the help of sensors and valves. It worked well without the need for manual operation and gave consistent results each time. This project is useful in the field of industrial automation, as it shows how PLCs can make processes faster, more reliable, and easy to control. It is especially helpful in industries like food, beverage, and chemicals, where mixing the right amount of liquids is very important. In real-life use, this system can be upgraded and used in factories for better control and safety. It can be expanded for bigger operations and connected to SCADA or HMI systems for easier monitoring. Overall, the project gives a smart and cost-effective solution for industries looking to improve their mixing process.

Working Model :

This project involved the development of a complete hardware-based working model. There was no simulation or theoretical study done. All components like the Delta PLC, solenoid valves, sensors, and mixing motor were physically connected and tested. It is a fully functional physical setup designed and implemented in real-time.

Project Outcomes and Learnings:

The main outcome of this project was the successful automation of a liquid mixing process using a PLC. It helped achieve accurate, efficient, and consistent mixing without manual effort. Through this project, I learned how to program and work with a PLC, which was not included in our curriculum. I also gained hands-on experience in wiring, component testing, ladder logic programming, and understanding how automation works in real-world industrial applications.

Future Scope:

1. Integrating SCADA for remote monitoring and real-time process visualization.
2. Adding HMI for a user-friendly interface to monitor and control system parameters.
3. Incorporating flow sensors to measure the exact quantity of incoming and mixed liquids.
4. Expanding the system to support multiple tanks for large-scale operations.