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Automatic Filling System Using PLC

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A B S T R A C T

The day to day inventions and innovations in the automation technology impact many industry processes. This includes the food industry, which needs the same technology innovations that have improved the filling, folding, sealing, taping, boxing, and picking and placing operations. Automating repetitive tasks will improve quality control and efficiency and reduce the high level of accidents. The proposed system is simple and economical system to fill any type of liquid items in a container automatically using Programmable Logic Controller (PLC). The total cost of the system can be reduced by using fixed type PLC with minimum number of input and outputs. This system helps the small scale industries and small organizations to use a standalone automated filling and packing system.

Keywords: Programmable Logic Controller, Ladder Diagram, Proximity Sensor, Solenoid Valve and Conveyor.

1. Introduction

In this bottle filling system where the bottles to be filled moves on the conveyor belt, and automatically detected by proximity sensor in the proper position and fill the liquid and also, once its filled, the next bottle in queue has the opportunity to fill up. If all this process is carried out manually, it will really take a long time. The PLC is the controller used for this type of standalone small scale system. The main advantage of using PLC as a controller is that the entire process can be simulated before it is implemented physically. Hence error rectification and any change of logics can be done in the simulation itself.

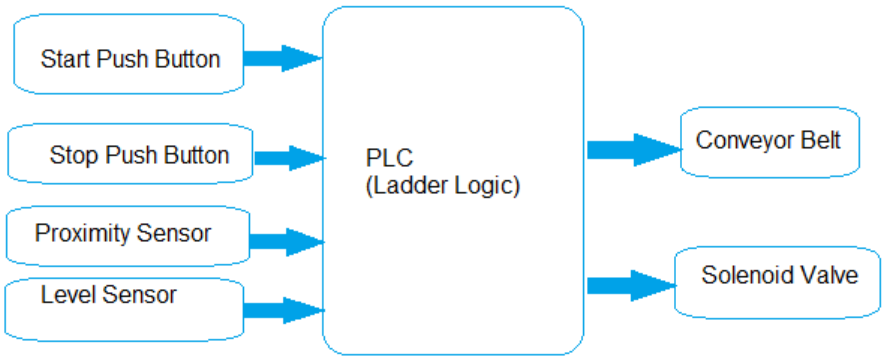

Figure1: Block Diagram

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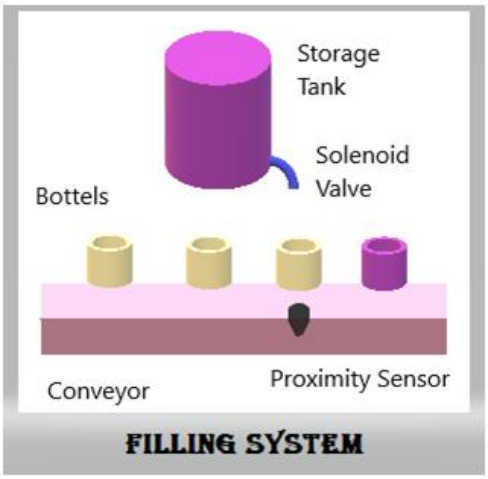

Figure 2: PLC Based Filling System

2. Programmable Logic Controller

A programmable logic controller or programmable controller is an industrial digital computer that has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, robotic devices, or any activity that requires high reliability, ease of programming, and process fault diagnosis. PLC is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices. However, the biggest benefit in using a PLC is the ability to change and replicate the operation or process while collecting and communicating vital information. The PLC used in this system is Allen-Bradley MicroLogix 1100 PLC.

Figure 3: Allen-Bradley MicroLogix 1100 PLC

3. Proximity Sensor

A non-contact type Proximity sensor is used to detect the presence of an object when the object enters the sensing range. There are different types of Proximity sensors like Capacitive type, Inductive type, Infrared sensors, light sensors and some sensors detects the object presence based on sound wave. Inductive Proximity Sensors detect magnetic loss because of the eddy currents that are generated on a conductive surface by an external magnetic field. An AC magnetic field is generated on the detection coil, and changes in the impedance due to eddy currents generated on a metallic object are detected.

Figure4: Proximity Sensor

4. Solenoid Valve

Solenoid valves are control units which, when electrically energized or de-energized, either shut off or allow fluid flow. The actuator takes the form of an electromagnet. A solenoid is a device comprised of a coil of wire, the housing and a moveable plunger (armature). When an electrical current is introduced, a magnetic field forms around the coil which draws the plunger in. More simply, a solenoid converts electrical energy into mechanical work.

Figure 5: Solenoid Valve

5. Conveyor belt

A conveyor belt works by two motorized pulleys that loop over a long stretch of thick, durable material. When motors in the pulleys operate at the same speed and spin in the same direction, the belt moves between the two. If object are particularly heavy or if the conveyor belt is carrying them for a long distance then a rollers may be placed on the sides of the conveyor belt for support.

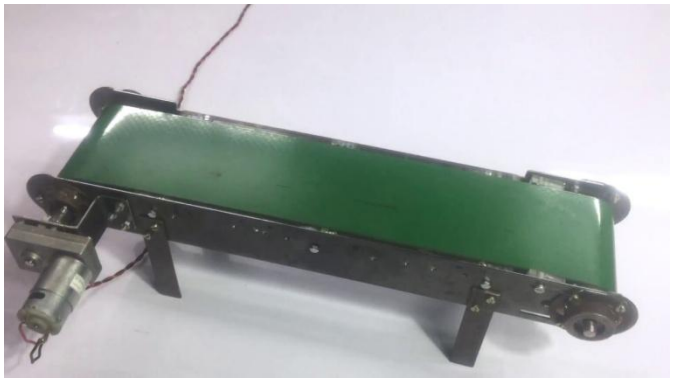

Figure 6: Conveyor Belt

6. Programming

Ladder Logic is the most commonly used PLC programming language. Ladder Diagram (LD) traditional ladder logic is graphical programming language. Initially programmed with simple contacts that simulated the opening and closing of relays, Ladder Logic programming has been expanded to include such functions as counters, timers, shift registers, and math operations. The software used for this system is RSLogix 500.

7. Sequence of Operation

Step 1. Start the system by pressing the start push button.
Step 2. Once the start push button is pressed the conveyor belt starts moving with empty bottles.
Step 3. When the proximity sensor senses the bottle in the conveyor belt. The belts will stop moving.
Step 4. After the proximity sensor senses the bottle with a delay of 2 sec & then the solenoid value turn ON to fill the bottle.
Step 5. Once the bottle is filled then the solenoid values closed.
Step 6. After a delay of 2 seconds the conveyor belt starts to move to position the next bottle in the conveyor.
Step 7. The sequence will repeat until the stop push button is pressed.

Table 1: Input Address Table

Appendix A. Input	Appendix B. Address
Appendix C. Start	**Appendix D. I:0/0**
Appendix E. Stop	**Appendix F. I:0/1**
Appendix G. Proximity Sensor	**Appendix H. I:0/2**
Appendix I. Level Sensor	**Appendix J. I:0/3**

Table 2: Output Address Table

Appendix K. Output	Appendix L. Address
Appendix M. Conveyor	**Appendix N. O:0/0**
Appendix O. Solenoid Valve	**Appendix P. O:0/1**

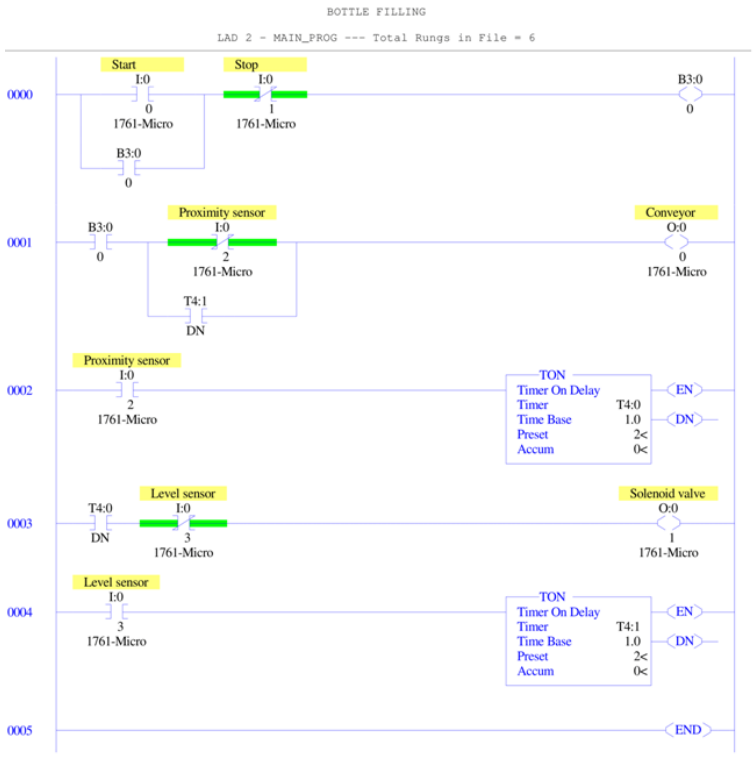

Figure 7: Ladder Logic

8. Result and Discussion

The system is working perfectly and fills the container one at a time. After the first container filled then it automatically fills the next in the queue. The liquid level in the container is automatically sensed by the sensor and the solenoid is closed, hence there is no chance of overflow of the liquid. The entire process will repeated again and again until the stop push button is pressed.

9. Future Enhancement

The Proposed system can be enhanced to Capping and Labeling by adding appropriate hardware and improved ladder logic. The same method can be used to automate a small sized packing and labeling system.

10. Conclusion

Automated system plays a vital role in small scale food manufacturing industries to improve their productivity, quality and hygiene of the product they made. The same system can be used in Hostels, Schools, Colleges, small hotels and domestic food processing systems.

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