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Automatic Water Filling Station using Plc Allen Bradley 1400

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Abstract *:* Introducing a cutting-edge solution for beverage industries, our paper unveils a revolutionary container filling machine employing state-of-the-art Programmable Logic Controller (PLC) technology. Crafted with simplicity and efficiency in mind, this compact system seamlessly integrates a conveyor belt type of circular plate for bottle transportation and a precision DC pump to regulate water flow with unparalleled accuracy Operating with finesse, a proximity sensor precisely detects bottle positions, triggering the pump to commence filling precisely at the opportune moment. Once the bottle is detected, a secondary sensor halts the conveyor(plate), initiating a 25-second pump operation optimized for filling up to 150 ml container swiftly and flawlessly. Upon completion, the pump gracefully ceases, and the conveyor(plate) resumes its smooth operation Notably, our system is designed with user convenience at its core.

A dedicated stop button empowers operators to halt operations instantly, ensuring safety and control. With each component meticulously optimized for performance and reliability, our cost-effective filling machine stands as a beacon of innovation, poised to revolutionize small-scale beverage enterprises, from cozy coffee shops to bustling juice bars and beyond. The PLC program is written in ladder logic or structured text, allowing easy modification of filling parameters such as time, volume, and conveyor speed. The system can be extended to include multiple filling stations placed along the same conveyor for higher throughput.

IndexTerms – PLC MICROLOGIX 1400, Proximity Sensor, Solenoid valve, DC Motor(12v)

1. INTRODUCTION

An Automatic Water Filling Station using a Programmable Logic Controller (PLC) is an industrial automation system designed to fill water bottles efficiently without manual intervention. In this system, the PLC acts as the main controller that continuously monitors and controls the entire process. The setup consists of components such as sensors to detect the presence of bottles, a conveyor belt or DC motor to move the bottles, and a solenoid valve to regulate the flow of water. When an empty bottle reaches the filling position, the sensor detects it and sends a signal to the PLC. The PLC then stops the conveyor and opens the solenoid valve to allow water to fill the bottle. After a predetermined time, the valve closes, ensuring accurate filling, and the conveyor resumes movement to carry the filled bottle away. This system reduces human effort, increases production speed, and ensures uniform filling, making it highly useful in industries such as water packaging, beverages, and liquid processing plants.

2. LITERATURE SURVEY

2.1 Introduction

The literature survey provides a detailed study of existing technologies and research related to automatic liquid filling systems using a Programmable Logic Controller (PLC). It helps in understanding the design, operation, and limitations of previously developed systems and forms a basis for developing an improved and efficient solution.

In recent years, many industries have adopted automation techniques to increase productivity and reduce human effort. Researchers have focused on developing automatic bottle filling systems using PLCs, sensors, and actuators to achieve accurate and efficient filling operations. These systems are widely used in water plants, beverage industries, and chemical processing units.

2.2 Existing Systems

Several automatic water filling systems have been developed using PLC technology and other control methods. Most systems use sensors such as proximity or infrared sensors to detect bottles and control the filling process. The conveyor system is used to move bottles, and solenoid valves are used to regulate the flow of liquid.

Some basic systems only automate bottle detection and filling but do not provide precise control over filling levels. Our system use timers in PLC programming to control the filling duration, which gives accurate values and we can change the timers based on container or bottle volume if required. In small-scale industries, manual or semi-automatic systems are still used, which require human intervention and reduce efficiency.

2.3 Review of Related Work

Several research works have been carried out in the field of automatic liquid filling systems:

1. A study on PLC-based bottle filling systems showed that sensors and timers can be used to automate filling operations effectively. However, the system mainly relied on time-based filling, which may affect accuracy.

2. Another research work focused on conveyor-based filling systems where PLC controls the movement of bottles and filling process. This system improved production speed but required proper synchronization between components.

3. Some researchers developed systems using level sensors to measure the exact liquid level inside the bottle. These systems provided better accuracy but increased system complexity and cost.

4. Automated filling systems using microcontrollers instead of PLCs were also developed for low-cost applications. However, these systems lack the robustness and reliability required for industrial environments.

5. Advanced systems integrate PLC with SCADA for monitoring and control, allowing operators to supervise the filling process in real time. However, such systems are expensive and require skilled operation.

2.4 Limitations of Existing Systems

Despite various developments, existing systems have several limitations:

1. Many systems depend only on timer-based filling, leading to inaccurate results
   Lack of precise level control in basic systems
2. High cost of advanced systems with SCADA integration
3. Complexity in system design and maintenance
4. Limited flexibility in handling different bottle sizes

5. Requirement of manual intervention in some systems

2.5. Proposed System

To overcome the limitations of existing systems, the proposed system uses a PLC-based automatic water filling station that integrates bottle detection, conveyor control, and accurate filling operation. A sensor detects the presence of the bottle, and the PLC controls the conveyor motor and solenoid valve accordingly.

When the bottle is detected, the conveyor stops, and the solenoid valve opens to fill water into the bottle. After a predefined time or level, the valve closes, and the conveyor resumes operation. This system ensures accurate filling, reduces human effort, and improves efficiency.

The proposed system is simple, cost-effective, reliable, and suitable for small- and medium-scale industries, providing better performance compared to existing methods.

3. METHODOLOGY

3.1 Introduction

The methodology describes the overall approach used to design and implement the Automatic Water Filling Station using a Programmable Logic Controller (PLC). It explains how different components such as sensors, PLC, conveyor motor, and solenoid valve work together to achieve automatic bottle filling. The system is designed to operate automatically when the power supply is turned ON.

3.2 System Overview

The proposed system is divided into three main stages: sensing stage, processing stage, and output stage. Each stage performs a specific function to ensure smooth and efficient operation.

3.3 Sensing Stage

In the sensing stage, a proximity or infrared sensor is used to detect the presence of an empty bottle at the filling position. The sensor continuously monitors the conveyor line.

When a bottle reaches the sensing point, the sensor detects it and sends a signal to the PLC. This signal acts as an input for further processing and control actions.

3.4 Processing Stage

The PLC acts as the central processing unit of the system. It receives the input signal from the sensor and processes it based on the programmed logic (ladder logic).

When the PLC receives the signal indicating bottle presence, it executes the control program. The PLC stops the conveyor motor and activates the solenoid valve for a specific time duration to fill the bottle accurately.

3.5 Output Stage

The output stage consists of two main components: conveyor motor and solenoid valve.

1. **Conveyor Motor**: The PLC controls the motor to move bottles along the conveyor. When a bottle is detected, the motor stops temporarily and restarts after filling is completed.

2. **Solenoid Valve**: The PLC activates the solenoid valve to allow water flow into the bottle. After a fixed time, the valve closes to stop filling.

3.6 Data Flow

The data flow in the system follows this sequence:

Sensor → PLC → Decision Making → Motor/Valve Control → Filling Operation

This flow ensures continuous operation and automatic control of the filling process.

3.7 Implementation Steps

The implementation of the system involves the following steps:

1. Connect all hardware components properly (PLC, sensor, motor, valve).
2. Provide power supply to the system.
3. Write and upload ladder logic program into the PLC.
4. Continuously monitor sensor input.
5. Keep conveyor running continuously
6. Repeat the process for continuous operation.

4. SYSTEM DESIGN :

The system design describes the architecture and arrangement of hardware and control elements used in the Automatic Water Filling Station using a Programmable Logic Controller (PLC). It explains how different components are interconnected and how the system is designed to achieve automatic and efficient bottle filling.

.4.1 Block Diagram

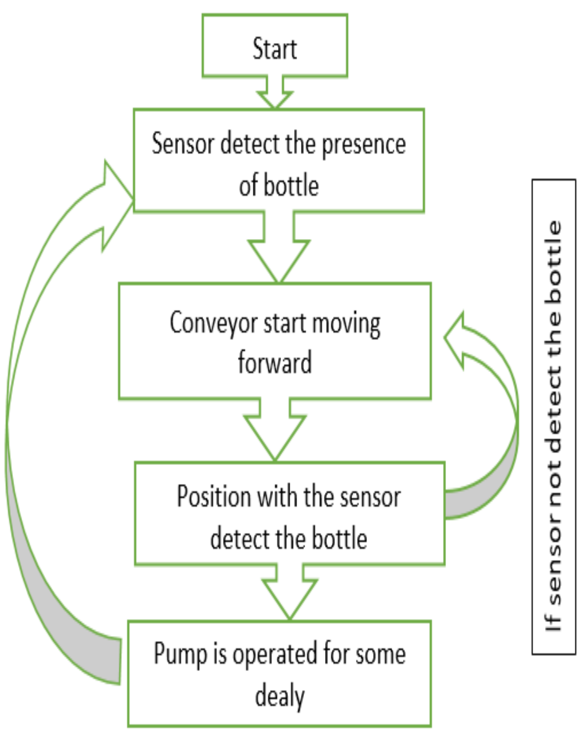

Fig.4.1. Block Diagram

- PLC
- Conveyor motor
- Sensors (Proximity/IR)
- Solenoid valve
- Water tank
- Power supply
- DC Motor
- Connecting wires
- Water Pipes
- Container
- Trainer Container
- Relay Module
- HMI

4.2 System Architecture

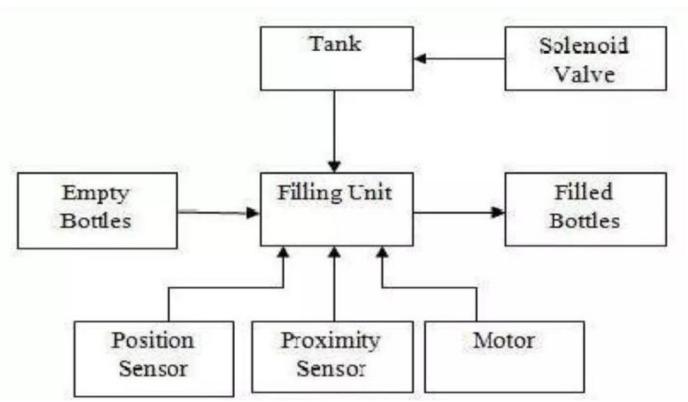

Fig.4.2. System Architecture

5.HARDWARE IMPLEMENTATION

The system uses an Allen-Bradley MicroLogix 1400 PLC, proximity sensor, DC motor, solenoid valve, and water pump.

The PLC acts as the central controller, while sensors provide input signals. Outputs control the motor and valve for filling operation. The system operates on a 24V DC power supply.

Fig. 5.1.Allen-Bradley MicroLogix 1400 PLC,

Fig.5.2.DC Gear Motor

Fig.5.3.Solenoid valve, and water pump.

6. SOFTWARE DESIGN

RS Logix 500 is the primary programming software for the Allen-Bradley MicroLogix 1400 series PLC. It is used to create and debug ladder logic, while RS Linx Classic is required for communication, usually via Ethernet or USB-to-serial.

Communication software

RS Linx is a software that is used to establish communication between Rockwell devices and Microsoft applications. Without this, you cannot even download a program in PLC. Also, the software allows for OPC DA communication.

Software & Hardware Compatibility

- **Series Support:** MicroLogix 1400 requires RSLogix 500 v8.10+ for Series A, and v8.30+ for Series B/C.
- **Operating Systems**: Works on Windows 7, 10, and 11.
- **Communication:** Ethernet is standard, but you may need an Allen-Bradley 1761-CBL-PM02 cable for serial communication.

Fig.6.1.*RSLogix 500*

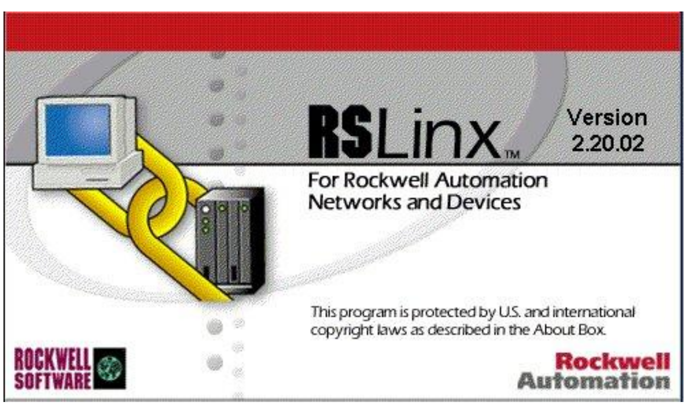

Fig.6.2.*RSLink Network*

7. PLC PROGRAMMING

Programming Language :

Ladder Logic Diagram (LAD) : Ladder logic is basically a program that is represented by a graphical diagram, which is based on a circuit diagram of relay logic. This program contains two vertical lines called 'rails' and horizontal lines called

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'rungs' which makes it look like a perfect ladder. The graphical representation of an ladder logic program is called as Ladder Logic diagram(LLD).

Input / Output Addressing

Inputs:

- I0.0 → Start Button
- I0.1 → Stop Button
- I0.2 → Sensor

Outputs:

- Q0.0 → Conveyor(motor)
- Q0.1 → Valve
- Q0.2 → Pump

Ladder Logic Description

Rung 1: Start/Stop Latch
Maintains system ON/OFF state

Rung 2: Conveyor Control
Runs conveyor until bottle detected

Rung 3: Filling Timer
Starts timer when sensor activates

Rung 4: Valve Operation
Valve ON during timer

Rung 5: Reset
System resets after filling

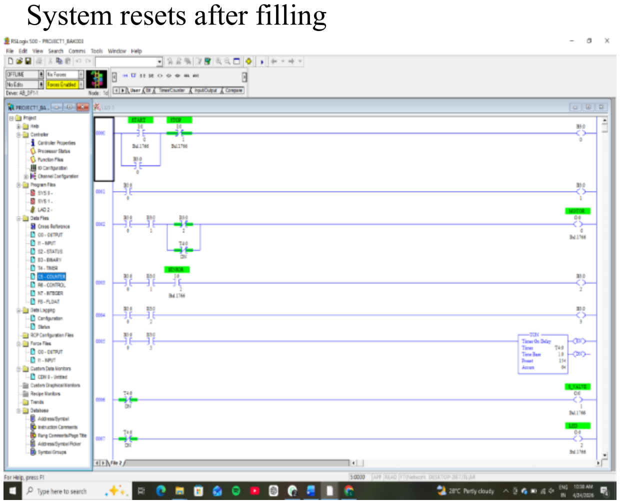

***Fig.7.1.**Ladder Logic*

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8. WORKING OPERATION

Working Principle:

The working principle of a PLC-based automatic water filling station is based on sensing, timing, and control operations. When the system is started, the conveyor belt moves bottles toward the filling position. A sensor detects the presence of a bottle and sends a signal to the PLC, which then stops the conveyor to position the bottle correctly. The PLC activates a solenoid valve to allow water to flow into the bottle while a timer controls the filling duration. Once the preset time is completed (or the required level is reached), the PLC closes the valve and restarts the conveyor to move the filled bottle away and bring the next empty bottle into position. This process continues automatically, ensuring accurate and efficient filling with minimal human intervention.

Step-by-Step Operation

1. Operator presses Start
2. Conveyor begins moving
3. Bottle reaches filling station
4. Sensor detects bottle
5. Conveyor stops
6. Valve opens → water fills
7. Timer completes
8. Valve closes
9. Conveyor restarts

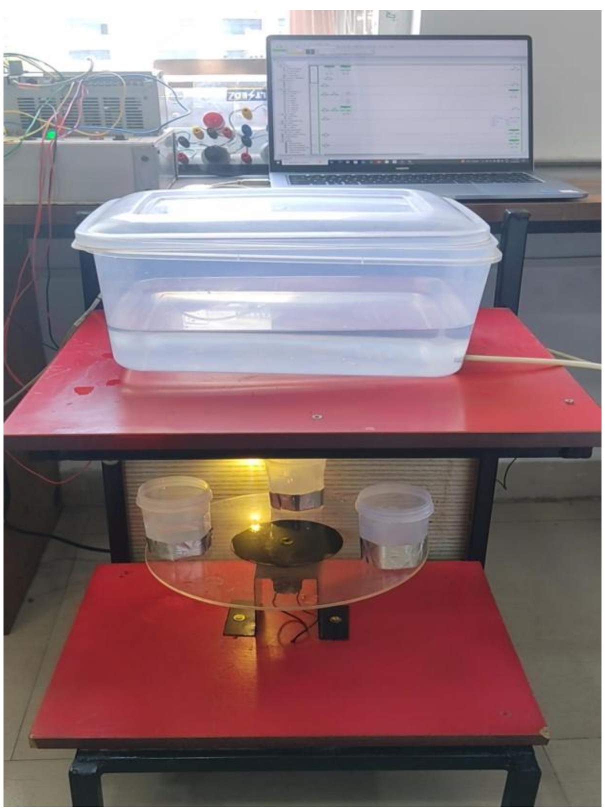

Fig.8.1.PLC based Automatic water filling station

RESULTS AND DISCUSSION

The developed system successfully performs automatic bottle filling with high accuracy and consistency.

The conveyor system ensures continuous operation, while the PLC maintains precise timing control.

The system reduces manual effort, increases productivity, and minimizes water wastage. It is suitable for small and medium industries due to its low cost and simple design

CONCLUSION

The PLC-based automatic water filling station successfully demonstrates the effective use of industrial automation in improving the efficiency and accuracy of liquid filling processes. By integrating key components such as sensors, a conveyor system, a solenoid valve, and a water pump under the control of a PLC, the system is able to perform continuous and precise operations with minimal human intervention. One of the major achievements of this system is its ability to provide **consistent and accurate filling** for each bottle. Unlike manual methods, where variations and human errors are common, the automated system ensures uniform output through programmed control. This not only improves product quality but also reduces wastage of water. The system also enhances **productivity and operational speed**. Since the process is continuous and automated, a large number of bottles can be filled in a shorter period of time. Additionally, the use of PLC makes the system highly reliable, flexible, and easy to modify.

FUTURE SCOPE

The future scope of the PLC-based automatic water filling station is highly promising due to rapid advancements in industrial automation and smart technologies. The system can be enhanced by integrating **SCADA (Supervisory Control and Data Acquisition)** for real-time monitoring, data logging, and remote control of the filling process. With the adoption of **IoT (Internet of Things)**, operators can monitor system performance, detect faults, and optimize production from anywhere using connected devices.

- SCADA integration
- IoT-based monitoring
- Multi-bottle filling system
- AI-based defect detection

Acknowledgment

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REFERENCES

- **"Programmable Logic Controllers" by Frank D. Petruzella:** A comprehensive, widely used text for beginners covering ladder logic and basic troubleshooting.
- **"Programmable Logic Controllers" by W. Bolton:** An essential text focusing on the principles and applications of PLC systems.
- **"Automating Manufacturing Systems with PLCs" by Hugh Jack:** A practical guide often used for, and available as, a free online resource.
- **"Programmable Logic Controllers: Principles and Applications" by John W. Webb & Ronald A. Reis:** Covers PLC hardware and software basics in industrial settings.
- **"Learning RS Logix 5000 Programming" by Austin Scott:** Specialized guide for Allen-Bradley ControlLogix/CompactLogix systems