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Development of PLC Controlled Automated Coffee Vending Machine

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Abstract: The project Development of PLC Controlled Automated Coffee Vending Machine focuses on designing an automatic coffee dispensing system using a Programmable Logic Controller (PLC). The system automates the process of preparing and dispensing coffee with minimal human intervention. It uses sensors, control valves and a PLC program to manage ingredient mixing and dispensing. The PLC controls the sequence of operations such as water heating, ingredient mixing and cup filling. This automation improves efficiency, accuracy and reliability of the coffee preparation process. The system reduces manual effort and ensures consistent quality of coffee. It is suitable for offices, colleges and public places where quick beverage service is required.

Index Terms - PLC, Automation, Coffee Vending Machine, Industrial Control System.

I. INTRODUCTION

Automation technology is widely used in modern systems to improve efficiency and reduce manual work. Coffee vending machines are commonly used in offices, colleges and public places to provide quick beverage service. A PLC Controlled Automated Coffee Vending Machine helps in preparing coffee automatically with minimal human effort.

The Programmable Logic Controller (PLC) is used as the main controller to manage the entire operation. It controls different components such as heaters, pumps, valves and sensors. The system follows a programmed sequence to mix ingredients and dispense coffee into a cup. This automation ensures consistent taste, accuracy and faster service. The project focuses on designing a simple, reliable and efficient automated coffee vending system.

II. LITERATURE REVIEW

Automated vending machines are widely used to provide beverages quickly and conveniently in places such as offices, colleges and public areas. Automation reduces manual work and improves service speed. According to Wang [1], automated vending systems help improve efficiency and maintain consistent product quality.

Programmable Logic Controllers (PLC) are widely used in industrial automation because they are reliable and easy to program. PLCs can control different operations such as heating, mixing and dispensing in vending machines. Zhang and Li [2] explained that PLC systems effectively control sensors, pumps and valves.

Several researchers have developed beverage vending machines using PLC technology. Chen et al. [3] designed a PLC-based beverage vending machine that automatically mixes ingredients and dispenses drinks based on user selection. Similarly, Kumar and Singh [4] developed an automated coffee vending machine using PLC programming. The system controls water heating, ingredient mixing and coffee dispensing through a programmed sequence.

Automation also improves hygiene and safety in beverage machines. Lee and Park [5] reported that automated systems reduce human contact with ingredients, which helps maintain cleanliness and product quality. Researchers have also used simulation tools to test vending machine operations. Gupta et al. [6] used PLC simulation software to check the system logic and avoid errors before real implementation.

Some studies focused on improving vending machine efficiency and reducing operational cost. Ahmed and Rahman [7] explained that automated beverage machines reduce labor work and increase service speed. Modern vending machines also include advanced technologies, including smart vending machines with remote monitoring to check machine status and ingredient levels. In addition, Patel et al. [9] proposed a vending machine system with an improved user interface that allows easy beverage selection and automated preparation. Finally, Lopez et al. [10] developed a prototype automated beverage dispenser controlled by PLC, demonstrating reliable heating, mixing and dispensing operations.

III. RESEARCH AND METHODOLOGY

The methodology for the PLC Controlled Automated Coffee Vending Machine involves designing and developing an automated system that prepares and dispenses coffee using a Programmable Logic Controller (PLC). First, the overall system is designed by identifying the main components such as the PLC controller, heater, pumps, valves, sensors and ingredient containers.

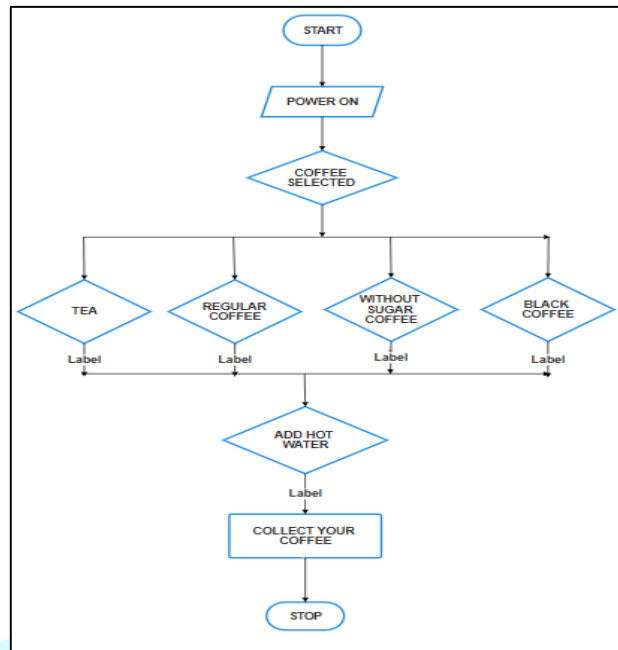
After selecting the required components, the PLC program is developed using TIA Portal V20 software. The control program is written using Ladder Logic, which is commonly used in PLC programming to control industrial automation processes. Input devices such as push buttons are connected to the PLC to allow the user to select coffee, while output devices like heaters, pumps and solenoid valves are connected to control the preparation process.

When the user presses the coffee selection button, the PLC activates the heater to heat water and then controls the pumps and valves to mix coffee powder and water in the correct proportion. After mixing, the prepared coffee is dispensed into a cup through the dispensing unit. Finally, the system is tested and verified to ensure proper operation, reliability, and efficiency of the automated coffee vending machine.

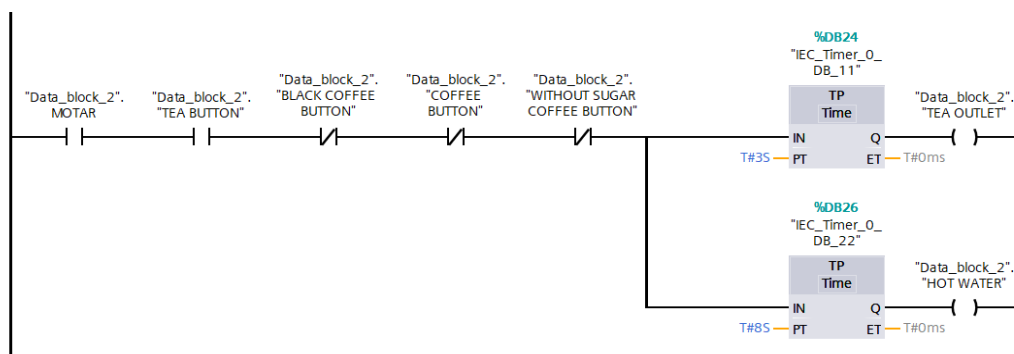
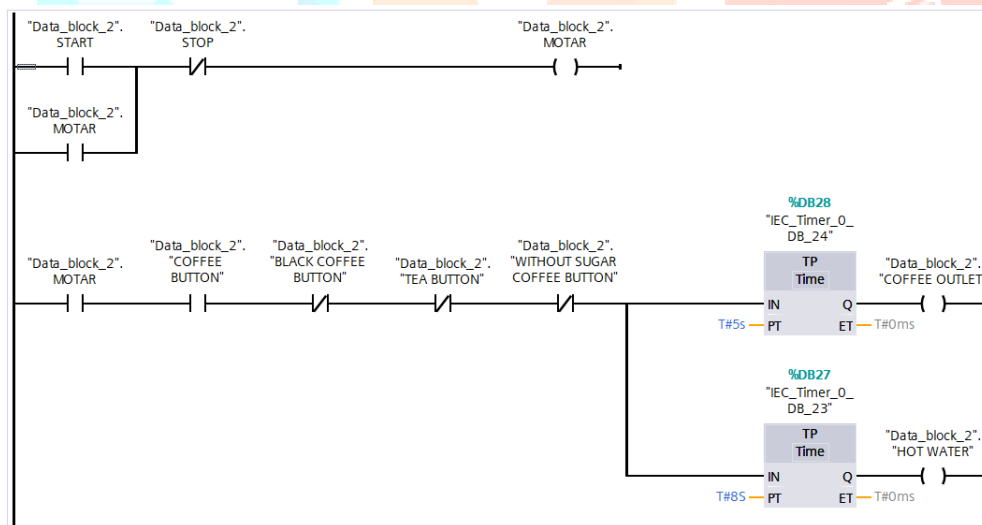
table 1: system components requirements

Sr. No	Components	Quantity
1	Programmable Logic Controller (PLC)	1
2	Switch Mode Power Supply (SMPS)	1
3	Relay Module	4
4	Solenoid Valve	4
5	DC motor	4
6	Temperature sensor	1
7	Level sensor (Float sensor)	1
8	Heating coil / heater	1
9	Mixing Chamber and Ingredient Container	4
10	Dispensing nozzle	8

Flowchart:



Ladder logic:



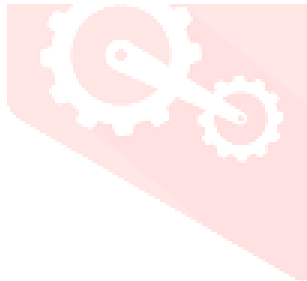
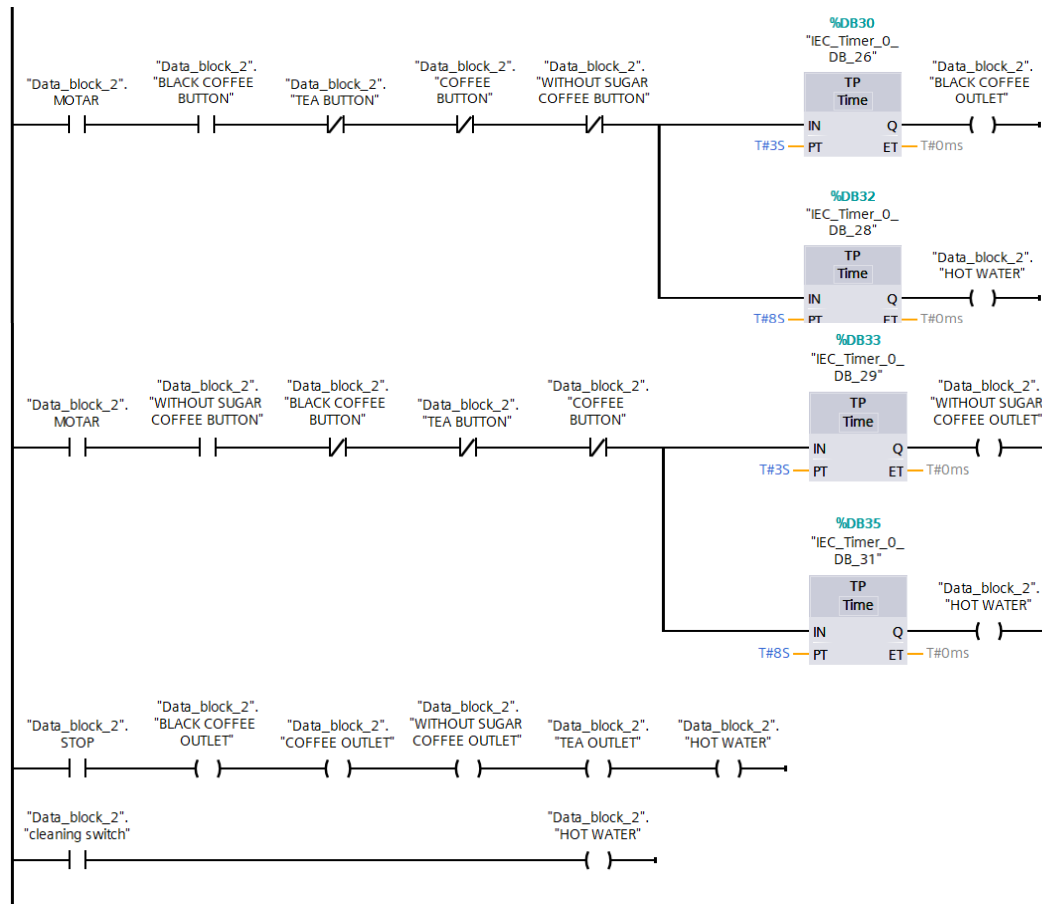


Diagram:**I. RESULT**

The development of the PLC controlled automated coffee vending machine showed significant improvement in efficiency, consistency, and ease of operation. During testing, the system successfully prepared coffee automatically with accurate mixing of water, milk, and premix according to the programmed sequence. The use of PLC ensured precise control over timing and dispensing, resulting in uniform taste and quality in every cup.

The machine reduced manual effort and minimized human errors, making the process faster and more reliable. It also demonstrated safe operation with proper control logic implemented through ladder programming in TIA Portal. Additionally, the system proved suitable for use in public places such as offices, colleges, and railway stations due to its quick response and hygienic operation.

Overall, the results confirm that automation using PLC in beverage dispensing systems enhances productivity, ensures consistent quality, and provides a user-friendly and efficient solution for modern needs.

IV. CONCLUSION

The PLC based coffee vending machine provides an automated and efficient way to prepare and dispense coffee. It reduces manual effort and ensures consistent quality in every cup. The system uses a PLC controller to manage operations such as water heating, mixing ingredients and dispensing coffee. The program was developed using TIA Portal with ladder logic programming. This makes the system reliable, easy to control and suitable for automation. Overall, the project demonstrates the practical application of PLC in modern automated vending systems.

V. ACKNOWLEDGEMENT

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