PLC Based Washing Machine

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Abstract - *This paper illustrates on the working of Automated washing machine by using programming logic controller. Hardware used in this project is PLC, solenoid valves, relays and DC Motor. PLC is used for the controlling of the devices and functions such are timing, sequencing, controlling, relaying and alarming were implemented. A DC Motor is implemented because of its variation over a wide range of speed. Solenoid is used for the control of water as an input and output valves of the machine. All the devices are fully controlled on a few instructions once given by PLC.*

Key Words: PLC(programmable logic controller),DC Motor, Ladder diagram, Solenoid valves, Relay.

1. INTRODUCTION

Now-a-days , people are living in such a tight schedule they don't have time to wash their clothes manually as well as it is much of a time consuming .In such cases plc based washing machine can be used which is easy ,reliable and time saving. Such washing machine once given a instruction performs its task efficiently. In this automated washing machine DC Motor is used which is capable of working at variable speeds as per one's requirement. The main purpose of the project is to have automated washing device which washes clothes and sheets without any human intervention.

The term is applied to machines that use water as a primary cleaning solution, as opposed to dry cleaning. Washing includes immersing, dipping, rinsing, soaking in water or other liquids, usually accompanied by soap, detergent or bleach. The simplest machines may simply agitate clothes in water while switched on; automatic machine may fill, empty, wash and spin in an automated complex cycle

2. SYSTEM BLOCK DIAGRAM

The three main components consists of inlet valve, motor control and the outlet valve which are controlled by the PLC(programmable logic controller). PLC controls the different operations of the machine.(Soak, wash, rinse and spin).

According to the instructions provided by the user PLC controls the whole functioning. For example, based on the water level set by the user, input valve remains ON for that particular time which is set for that level. PLC reads the user's instructions and displays the status of the washing machine using different LED.

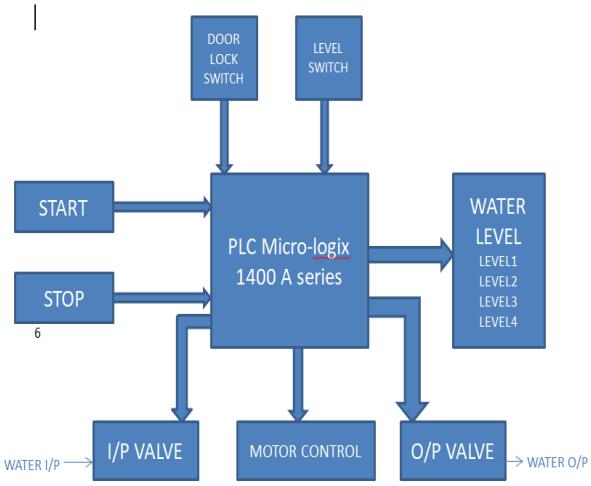


Figure 1: Block Diagram

Door lock switch remains ON during machine operation and also ensures that the door of the washing machine is closed, if unexpectedly user opens the door, the door lock switch gets open and it sends signal to PLC and whole operation of the machine stops.

3. ALGORITHM

Start the washing machine by pressing the 'START' switch. Set the timer for the water level by pressing the 'LEVEL SWITCH'.
The inlet valve is on for that particular time set by the timer. Ensure that the 'DOOR LOCK SWITCH' is on.

STAGE 1:

- Motor running
  -Forward direction for 5sec.
  -Reverse direction for 3sec.
  (This occurs for 2min.)
  -Forward direction for 60 sec.
- Motor stops running
- Outlet valve remains 'ON' for 60 sec.

STAGE 2:

- Again inlet valve remains ON for time set by level switch.
- Motor starts running
  -Forward direction for 60 sec
- Motor stops running
- Outlet valve remains ON for 60 sec

STAGE 3:

- Motor running
  -Forward direction for 120 sec
- Motor stops running
- Alarm starts ringing.

4. FLOW CHART:

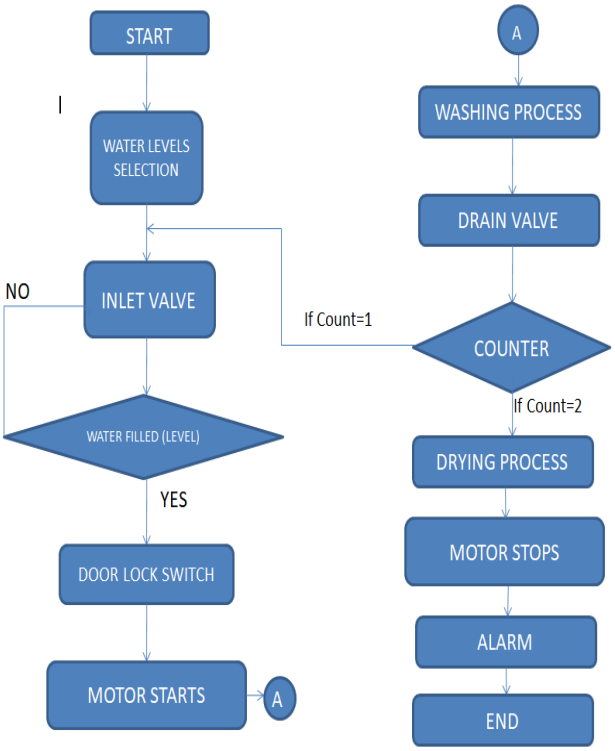


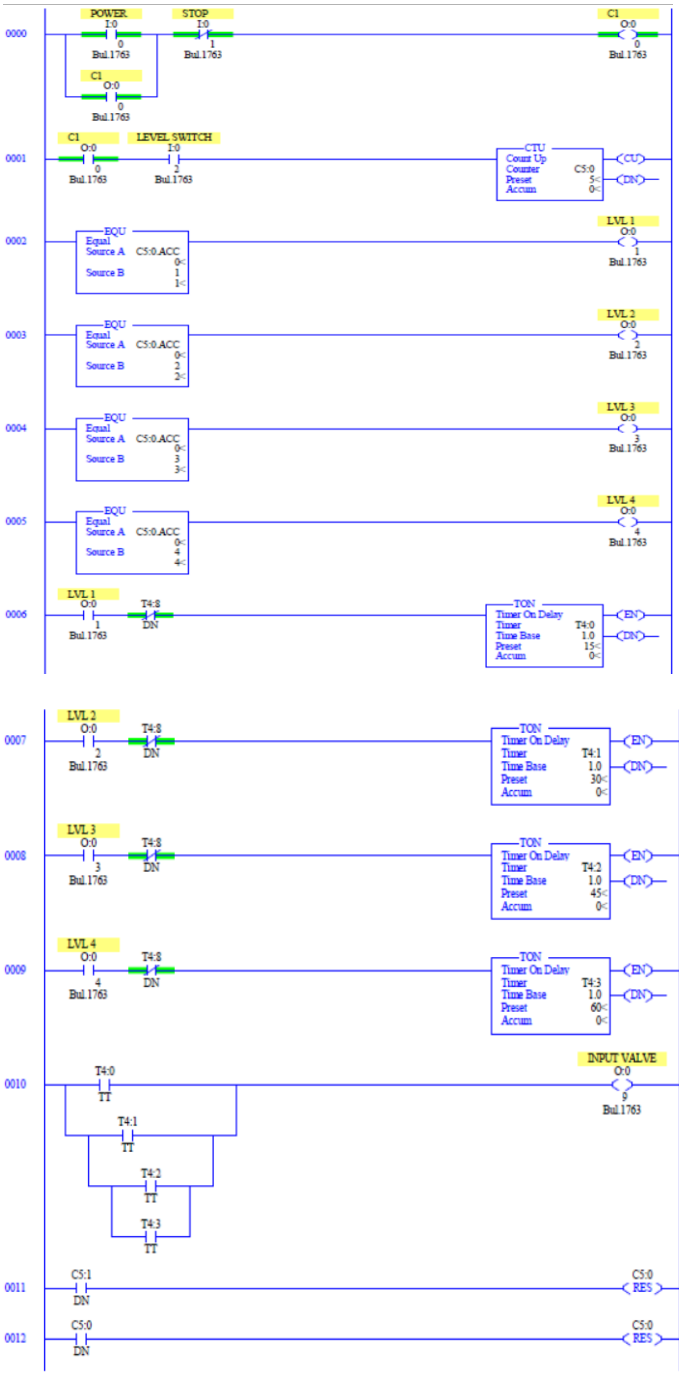
Figure 2: Flow chart

When user press the START switch, one should select the water level depending upon the quantity of clothes which are being washed. Here we are using timer to limit the level of water, as output of timer is given to the inlet valve. For example for level 1, timer is set for 15 sec and for level 4, timer is set for 60 sec, which means when user selects water level 4 then inlet valve remains ON for 60 sec. Further after water gets filled in the drum to the set level, PLC ensures that the door lock switch is ON i.e door of washing machine is closed. After that motor starts rotating based on the algorithms set in stage 1 i.e. in forward and reverse direction. In this stage soaking and washing of clothes takes place. After completion of stage 1 drain valve opens and removes all the water from the drum. In second stage again water is allowed through inlet valve up to the level set by the user, and motor starts to rotate as per the algorithms set in the program, and further water is drained out through outlet valve. In this stage rinsing of clothes takes place. In the third stage motor rotates in forward direction with no water in the drum. Thus remaining water from clothes get drain out due to centrifugal force, this process is known as spinning. After completion of all the three stages, motor stops and alarm goes ON.

5. LADDER DIAGRAM

RSlogix Micro software by Rockwell automation is used for testing purpose. Whereas allen bradly PLC of 1400 series is used during hardware implementation. RSLogix 500 benefits include:

- Cross-reference information
- Drag-and-drop editing
- Diagnostics
- Dependable communications
- Database editing
- Reporting



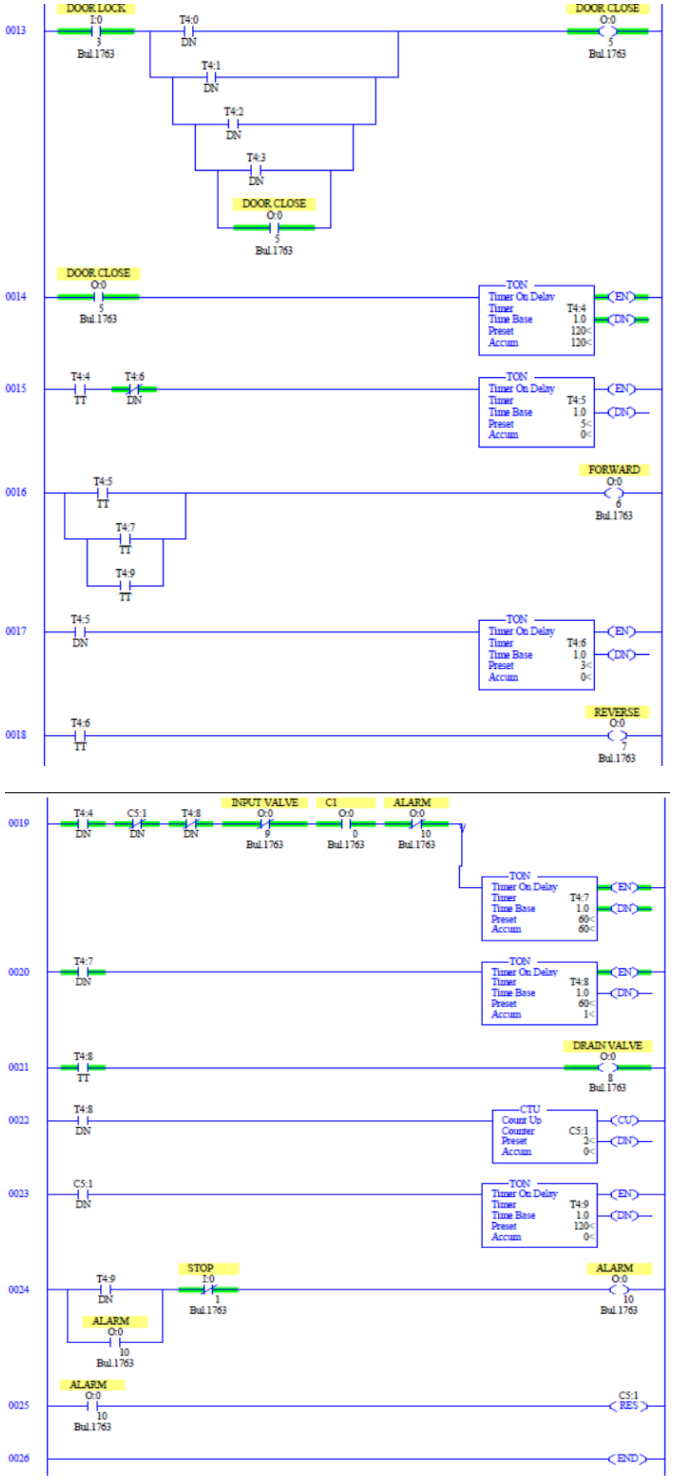


Figure 3: Ladder Diagram

6. HARDWARE IMPLEMENTATION

We had designed prototype of PLC based washing machine to get rough idea of various functioning and implementation process. For this we had used allen Bradley PLC of 1400 series, two solenoid valve, DC motor, four relays and few patch cords. Relay circuit is connected on the PCB as per the relay logic to get desired output. Different motoring conditions are obtained through relay circuit. This relay's input are connected to PLC through various patch cords and relays output is given to motor, inlet valve, outlet valve and buzzer. Just for project purpose motor operations are being carried out in two different drums one for motoring operations and other for different valve operation, so that we get a clear image of various motoring conditions. This whole assembly is mounted over cardboard as shown in the fig below.

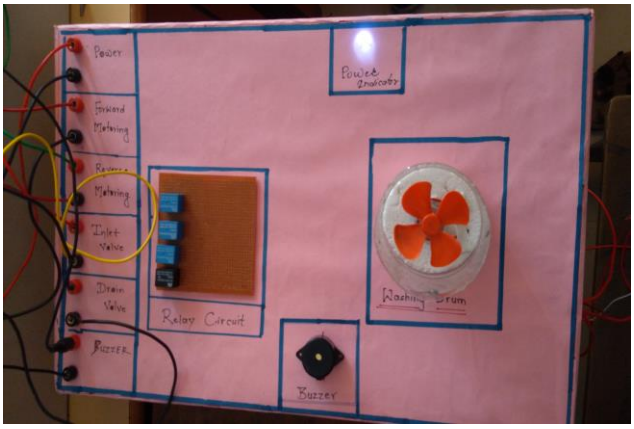


Figure 4: Hardware Layout

6.1 ALLEN BRADLEY MICROLOGIX 1400 SERIES PLC

Figure 5: Allen Bradley PLC

The Allen-Bradley MicroLogix 1400 from Rockwell Automation is implemented in this project. It combines the features that demand from MicroLogix 1100, such as Ethernet/IP, online editing, and a built-in LCD, plus provides an enhanced features, such as: faster High Speed Counter/PTO, higher I/O count and enhanced network capabilities.

6.2 SOLENOID VALVE

A solenoid valve is an electromechanically operated valve. The valve of solenoid is controlled by the current flowing through a solenoid: In two-port valve the flow is switched either on or off whereas in three-port valve, the two outlet ports switch the outflow between them.

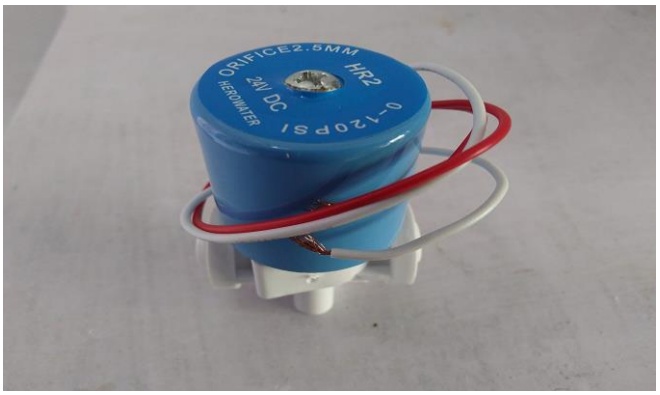


Figure 6: Solenoid Valve

This valves are the most used control elements in fluidics. Their work is to shut off, release, dose, distribute or mix fluids. Solenoids provide high reliability, fast and safe switching, long service life, good medium compatibility of the materials used, low control power and compact design.

Solenoid valves are implemented in fluid power pneumatic and hydraulic systems, to control cylinders, fluid power motors or larger industrial valves. Domestic washing machines use this valves to control water entry into the machine. Solenoid valves are usually called as "solenoids."

We are using two solenoid valve one as an inlet valve and other for outlet valve. When an external signal of 24v is provided to solenoid valve both valve operate and allows flow of water. In this case 24v signal is provided by PLC.

6.3 RELAY

Figure 7: Relay

A relay is an electrically operated switch. To mechanically operate a switch many relays uses an electromagnet, but other operating principles are also used, such as solid-state relays. Relays controls the circuit by a separate low-power signal, or either several circuits must be controlled by one signal.

In our project we used four relays which operate at 24V. One relay is for obtaining forward motoring condition second is for reverse motoring condition and other two relays are used for controlling inlet valve and outlet valve. Voltage which is required to operate these relays is supplied through PLC output.

6.4 DC MOTOR

Figure 8: DC Motor

A DC motor is a machine that converts direct current (DC) electrical energy into mechanical energy(ME). Almost all types of DC motors have some internal mechanism, either electromechanical, to change the direction of current flow in part of the motor.

DC motors were the firstly used, as they could be powered from existing DC lighting power distribution systems. A Direct –current motor's speed can be controlled over an extensive range, using either a variable supply voltage or by changing the strength of current in its field windings. Small range DC motors are implemented in toys, tools and appliances. Large range DC motors are used in elevator and steel rolling mills propulsion of electric vehicles.

DC motor of 24v is used inside the washing drum for washing clothes. 24v supply is provided to the dc motor through relay using PLC. The reverse and the forward motoring condition is achieved using different conditions of relays.

7. CONCLUSION:

PLC is being extensively used for various applications for automization. So use of this technology to carry out different washing operations in washing machine (soaking, rinsing, spinning, etc.) with precise control has been achieved.

Figure 9: Hardware Implementation

REFRENCES:

[1] V.V.S.Madhuri, Naveen Yerrathota "Automatic washing machine using PLC," International Journal of Latest trends in Engineering and Technology: Vol 7 issue 2, july 2016.

[2] www.literature.rockwellautomation.com

[3] www.wikipedia.org