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Real Time Automation Applications Using Millenium Crouzet PLC

V.V.S. Madhuri*

Abstract : Automation in different real time applications using PLC is tested and demonstrated. The controller employed is Millennium Crouzet PLC. Number of applications like Bottle Filling ; Washing Machine ; spray paint process ; traffic signal system ; soil irrigation system ; Smart Home With Automatic Door Control And Water Tank Controller are demonstrated. Electric devices such as DC Motors, Single-phase Induction Motors, LEDs, lamps, submersible water pumps, solenoid valves etc work according to the command from the controller in response to the designed Ladder Logic / Functional Block Diagram. The control is designed from the signals obtained from different types of sensors like proximity sensor, timers, soil moisturizer sensor, LDRs, float sensors etc.

Keywords : Millennium Crouzet PLC, Sensors, Ladder Logic, Functional Block Diagram, Automation.

1. INTRODUCTION

Automation in real time applications is encountered by various technologies like microprocessors ; ANN ; DCS (Distributed Control System) ; HMI ; SCADA ; PLC ; Instrumentation ; Robotics ; Motion Control etc.

This paper presents the functioning of PLC in above mentioned applications. PLCs are usually employed in industrial automation. PLC is a microprocessor used for automation. These controllers are specially designed to survive in harsh situations and external environmental factors. PLC consists of a microprocessor which is programmed in Ladder Logic or FBD. PLCs were first introduced in late 1960s.

PLCs are integrated as either single or modular units such as Integrated/Compact; Modular; Small; Medium and Large PLCs. Some of the manufacturers or types of PLCs:

- ALLEN BRADLEY (AB)
- ABB (ASEA BROWN BOVER)
- SIEMENS
- OMRON
- HONEYWELL
- SCHNEIDER ELECTRIC
- MITSUBISHI
- HITACHI
- DELTA
- GENERAL ELECTRIC (GE)
- MODICON
- CROUZET MILLENIUM PLC.

2. MILLENIUM CROUZET PLC

Crouzet Automation is user friendly, easy – to – use software. These products are suitable for integration in a wide range of applications. This controller enables the control and monitoring of machines or automation installations with up to 50 I/Os. The 12V or 24V DC millenium includes a variety of versions and is compatible with a large range of accessories.

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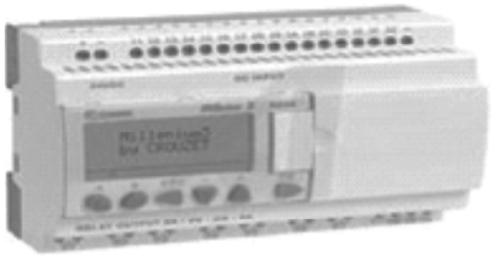

Description of XD 26 PLC

Part Number	Power Supply	Inputs	Output
88970162	24 V DC	16 digital (of which 6 are analogue)	10 Discrete Static Relay Outputs

Fig. 1. : XD26 PLC.

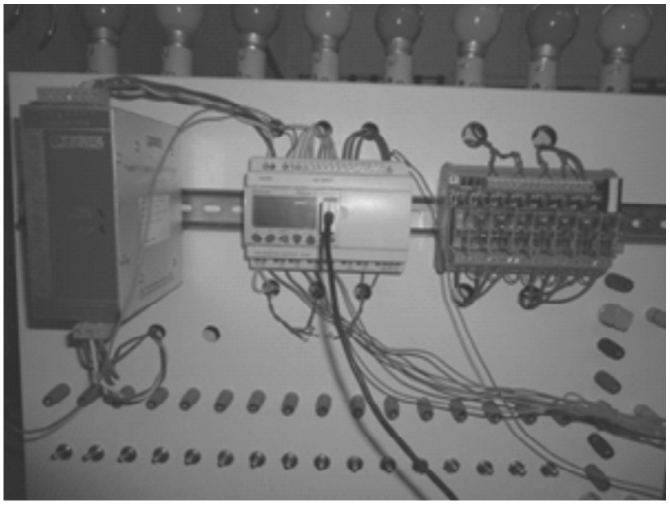

Fig. 2. XD 26 on panel board.

The expandable version XD26 is the module employed in applications mentioned here. Figure 1 and Figure 2 show the hardware set up of XD26 PLC. XD 26 PLC can be designed in such a way that Digital I/Os, analog inputs and discrete static relay outputs are user choice. The sum of these inputs and outputs give 26. The above figure shows the XD 26 PLC mounted on a panel board, used for experimental purpose.

3. DESCRIPTION OF CASE STUDIES

Hardware setups are demonstrated using PLC for the following cases :

1. **Bottle Filling :** The hardware, referred in Figure 3, shows a demonstration of industrial automation and aimed towards achievement of higher productivity, superior quality of end product, efficient usage of raw materials and energy, improved safety in working conditions.

   Single phase Induction motor is used for running the conveyor belt. A VF Drive is used in achieving required speed for the motor [8], [9]. The conveyor belt rollers are coupled to the motor shaft. The proximity sensors on the belt are used to stop the movement of the belt when required and opens the solenoid valves for the liquid flow.

   A container kept on conveyor belt is detected using proximity sensors. Two different liquids are filled in the container using solenoid valves and stirred to obtain a mixture. A DC motor is used for mixing the liquids. Final solution is filled in the container and the conveyor belt starts moving until it is detected by a third sensor. A ladder diagram is developed for the same as explained above and shown in Figure 4.

Fig. 3. Experimental set up for bottle filling

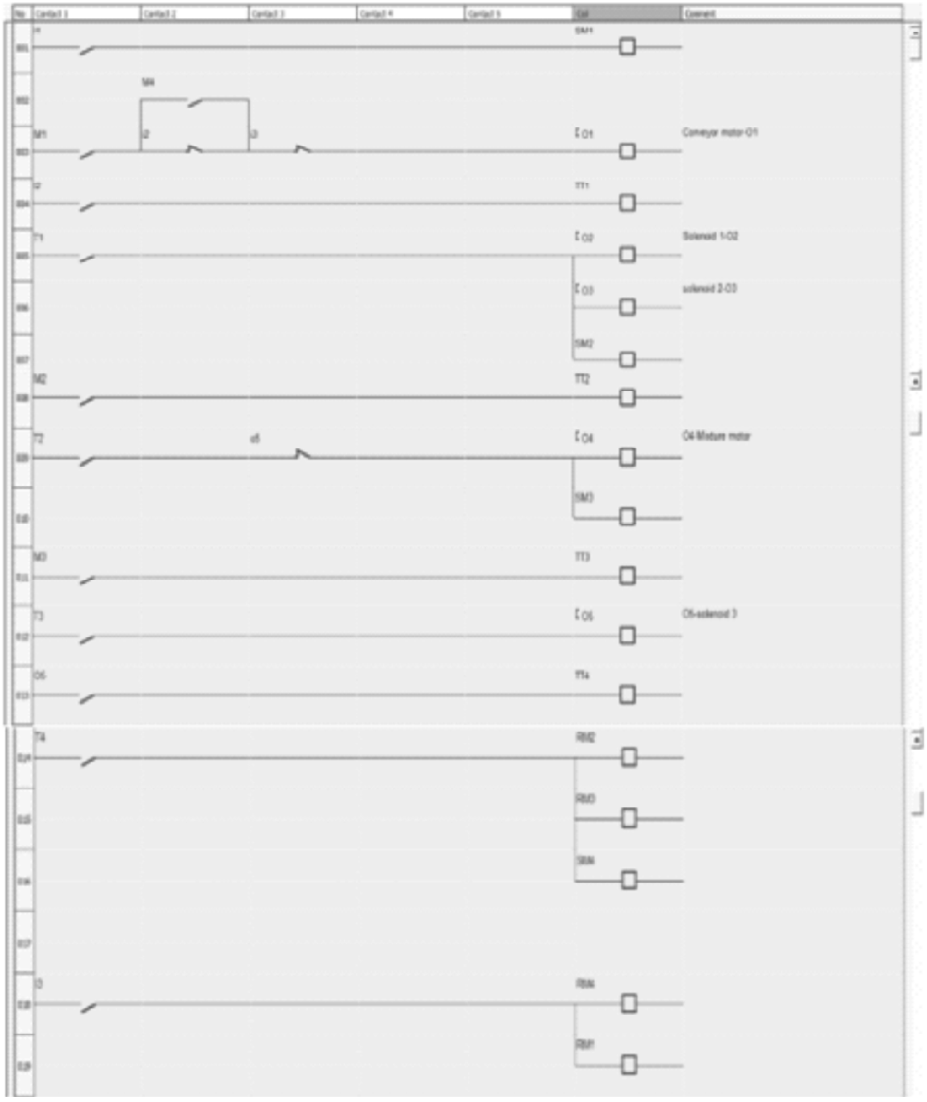

Fig. 4. Ladder Logic for Bottle filling

2. **Washing-Machine :** A complete automatic washing machine is demonstrated using PLC, as shown in Figure 5. This involves a split-phase induction motor with direction control and two solenoid valves for water inlet and outlet. Regulators are used for running the motor in required speeds. Ladder Logic is developed to execute a sequence of steps with the above mentioned setup. Sequence of steps like:

   Step 1 : water inlet

   Step 2 : time delay for soak

   Step 3 : motors rotates forward and reverse for 3 cycles (wash)

   Step 4 : water outlet opens and closes; inlet opens and closes

   Step 5 : motor rotates at a different speed for 3 more cycles (Rinse)

   Step 6 : water outlet opens and closes

   Step 7 : motor rotates at a higher speed in a single direction (dryer)

   Stop.

Fig. 5. Experimental set up for Washing Machine with Internal view.

The Ladder Logic as per the above algorithm is referred to in Figure 6.

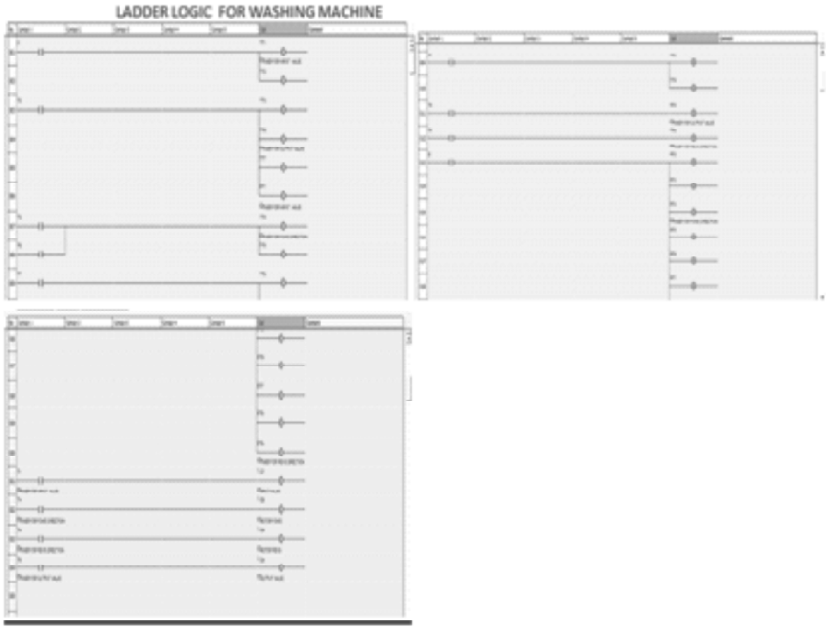

Fig. 6. Ladder Logic for Washing Machine.

3. **Spray Paint Process :** Automatic painting of an object is demonstrated. The object is brought till the paint valve on a conveyor belt. The object is detected using a proximity sensor and conveyor belt stops. The paint is sprayed around the object. The rotating motion and pressing/spraying are obtained by DC motors. Once the process is done, some time delay is provided for drying and the conveyor belt restarts, the object is displaced. The Hardware set up is shown in Figure 7.

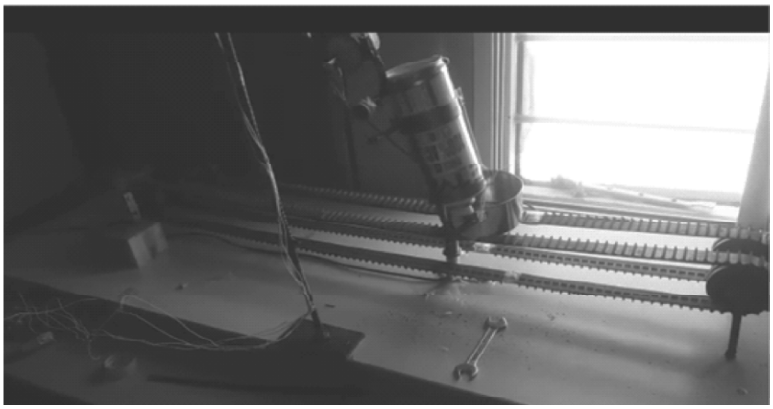

Fig. 7. Experimental setup for Spray Painting.

4. **Traffic Signal System :** Automatic traffic control along with automatic street lighting (based on Real Clock) is designed and demonstrated as shown in Figure 8, in two methods: (*i*) using timer (*ii*) using sensor, detecting traffic density. [8]

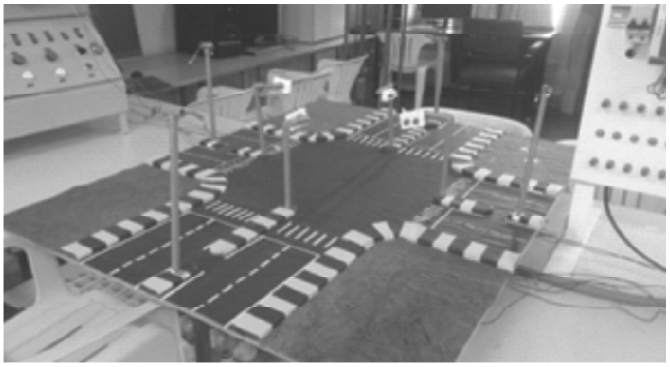

Fig. 8. Experimental setup for Automatic Traffic Control and Street lighting.

The programming is done in Functional Block Diagram (FBD) referred in the figure Figure 9.

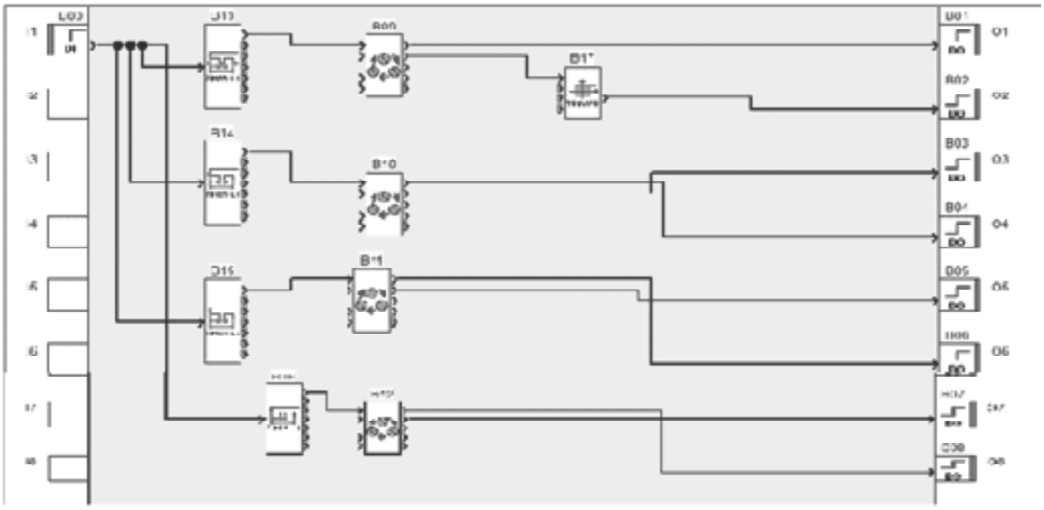

Fig. 9. FBD for Traffic control

5. **Soil Irrigation System :** Automatic water sprinkling system is done in two methods: (*i*) using timer and Real Clock (*ii*) using sensor, detecting soil moisture if reduces below a preset value the motor of sprinkling system starts/stops. The hardware set up is shown in Figure 10.

(*a*) (*b*)

Fig. 10. (*a*) Ladder logic with Real clock for Soil Irrigation, (*b*) Experimental setup.

6. **Smart Home with Automatic Door control and Water Tank Controller :** A smart home is demonstrated as shown in Figure 11. Automatic door opening and closing is provisioned with a human detecting sensor. The same technique also demonstrates automatic lighting of the house. Automatic water tank controller involves submersible water pumping motor and two float sensors.

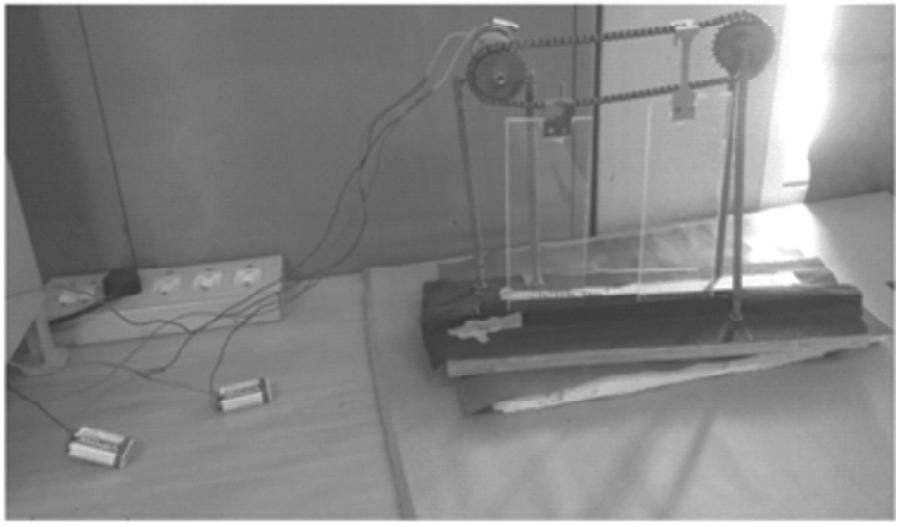

Fig. 11. Experimental setup for Automatic Door control.

5. HARDWARE SETUP

The above described demonstrations include the following devices in their hardware setup.

- Single Phase Induction motor of 1hp rating, controlled by a SK Emerson VF Drive. The drive is setup in voltage preset mode to control the speed of motor.
- Low rpm dc motors are employed.
- Proximity Sensors are used for sensing the presence of metallic objects.

6. CONCLUSION

Applications like Bottle Filling ; Washing Machine ; spray paint process ; traffic signal system ; soil irrigation system ; Smart Home With Automatic Door Control And Water Tank Controller are common day to day requirements we come across in real life. Automation of this type of applications lead to a smarter way of life. The case studies demonstrate application of automation in real life using a Programmable Logic Controller. PLCs are more advanced and economical than other conventional techniques. Many of these require a wide future scope in implementation. These inspire for the laboratory study and development in automation.

7. ACKNOWLEDGEMENT

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