Undergraduate Project Report

East West University

Department of Electrical and Electronic Engineering

Project Report

on

PLC Controlled Automatic Bottle Filling System

by

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Approved by

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Abstract

Programmable logic controllers (PLC) are used in places where automatic control of the machineries is required. They are especially useful in industries to run various tasks without human intervention, so, PLCs are now used in many industries where process automation is required. They are built to withstand the harsh environment of the factory floors and have greater immunity to noise and vibrations. However, to use a PLC to control a process, it needs to be programmed according to the requirement of the process to be controlled.

In many industries (such as pharmaceuticals, beverage industries etc.), bottles are required to be filled-up with a pre-determined amount of liquid. The filling process is usually kept automated to ensure a higher production rate and to lessen the burden on human resources, since the human operator is required to take only a supervisory role here. The whole process of bottle filling is therefore performed automatically through machines which are controlled by PLCs.

In our project, we have built a PLC controlled automatic bottle filling system. We made a mechanical model of the industrial filling system, complete with sensors, motors, actuators etc. and controlled the whole process of bottle-filling using the PLC available in the EEE laboratory. The system consists of an assembly line, and when a bottle reaches the filling station, a fixed amount of liquid is filled into the bottle, and then it moves towards the end of the assembly line to make way for another bottle to be filled-up.

Although this type of PLC controlled systems already exist in the industries, but through designing and implementing the system ourselves, we obtained experience on how to design practical industrial systems and control those using PLCs.

Acknowledgment

First of all, we are grateful to the almighty Allah for giving us this opportunity to complete the project.

We would like to thank Dr. Halima Begum, Assistant Professor, Department of Electrical and Electronic Engineering (EEE), East West University (EWU), Dhaka, our supervisor, for her constant guidance, supervision, constructive suggestions and constant support during this project work.

We are grateful to Dr. Mohammad Mojammel Al-Hakim, Associate Professor and Chairperson and Dr. Anisul Haque, Professor, Department of Electrical and Electronic Engineering (EEE), East West University (EWU), for their valuable suggestions and help. We would also like to thank our academic advisor Dr. Muhammad Mazharul Islam and also other faculty members, office staffs and East West University (EWU) in general.

At last we want to thank our parents and all our friends for their moral support and helpful discussion during this project work.

Approval

The project work titled 'PLC Controlled Automatic Liquid Filling System' submitted by Md. Mahadi Hasan (2009-2-80-056), Fuaduzzaman (2009-2-80-051) and S.M. Moinuddin (2009-2-80-017) in Summer, 2013 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Science in Electrical and Electronic Engineering of East West University (EWU).

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Authorization

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S.M. Moinuddin

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Chapter 1

Introduction

1.1 Objective

Many industrial processes are now dependent on automatic machinery. The transition from manual systems to automatic systems was necessary to optimize the rate and capacity of production [1]. To control an industrial process, a special microprocessor based controller called the programmable logic controller (PLC) is used. There are many advantages of using PLCs in process control. These controllers are built to withstand the harsh environment of industry floor (i.e. protected against dust, moisture, hot and cold temperatures etc.), so these do not need special housing or protection. The PLCs are also built in a way so that the electronic circuitry of the controllers is not affected by moderate amount of noise.

A more attractive feature which made PLCs so popular is that, the same PLC can be re-programmed (using only software) to perform another task or control another process. Before the introduction of PLCs, electrical relays were used to automate processes, and the relays needed to be physically re-wired if these were intended to control another process. PLCs can be programmed many times to do different tasks. Besides in industries, PLCs are also used in building management systems (BMS), amusement parks, mills, water and waste treatment plants etc. The PLCs read the input states of switches, sensors etc. and can drive motors, relays, solenoids etc.

One of the many uses of PLCs in industries is in assembly lines involving packaging. Especially in pharmaceuticals, beverage industries, mineral water packaging plants etc., it is required to fill-up a bottle with a certain amount of liquid. In these systems, empty bottles are put on a conveyor belt which brings these to the filling station. At the station, the bottles are automatically filled-up and then moved along the conveyor for further stages to perform other tasks such as cap fitting or packaging etc.

1.2 PLC Controlled Automatic Bottle Filling System

As part of our undergraduate project, we have developed a hardware model of a liquid filling system, and the process is controlled using a PLC. It is an automatic process where empty bottles are first placed on the conveyor belt. As an empty bottle is brought to the filling station, the belt stops to let the bottle fill-up with a fixed amount of liquid. The liquid is kept at an overhead tank near the filling station. After the bottle is filled-up, the belt starts again to move away the filled-up bottle and to bring another empty bottle to the filling station.

The whole process consists of three tasks:

- Filling bottles one after another with the desired level of liquid.
- Timely refilling the overhead tank to continue smooth operation.
- Controlling of the liquid flow from the reservoir to overhead tank.

1.3 Features of the Proposed System

Our proposed system has the following features:

- Detection of the presence of a bottle using sensor
- Timer based automatic bottle filling
- Control of the liquid level of the overhead tank

Although this type of PLC controlled systems already exist in the industries, but we obtained valuable practical experience on how to design a real industrial system and control a process using PLCs while designing and implementing the project.

Chapter 2

Description of the Proposed System

2.1 Working Principle

The design of the system can be divided into several parts. They are (1) the conveyor belt mechanism to move the bottles from one end of the assembly line to the other, (2) the mechanism for accurate positioning of the bottles under the overhead tank to be filled up by liquid, (3) the mechanism for controlling the flow of liquid to the bottle, and (4) liquid level maintaining mechanism at the overhead tank.

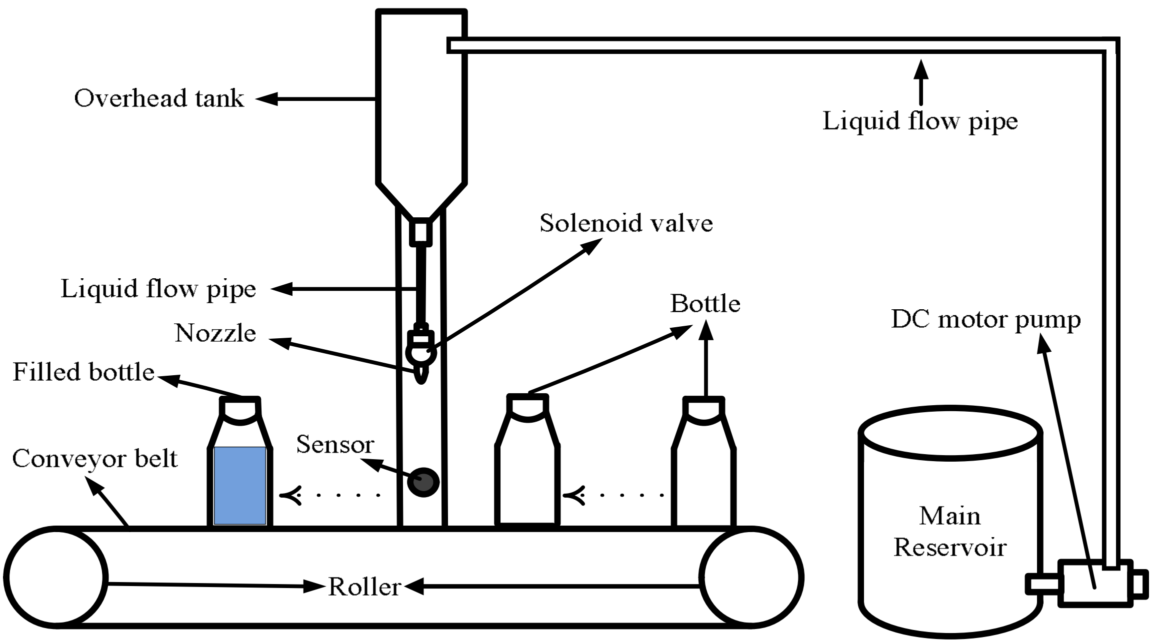


Figure 2.1: Schematic diagram of PLC controlled automatic bottle filling system

Figure 2.1 shows Schematic diagram of the PLC controlled automatic bottle filling system.

2.1.1 Conveyor Belt Mechanism

The conveyor belt mechanism (Figure 2.1) consists of a belt and rollers with DC gear motor. It is coupled with two rollers and runs continuously with the support of a DC gear motor when a start button is pressed. The conveyor belt carries the bottle along the assembly line to be filled up with liquid up to a particular level and then the conveyor belt runs again to take the filled up bottle to the other end to be collected by an attendant.

2.1.2 Bottle Detection Mechanism

The task of bottle detection is performed using a photoelectric sensor. A photoelectric sensor (Figure 2.1) is placed beside the conveyor belt at the filling station to detect the presence of a bottle. The sensor has an infrared light transmitter and a receiver. When a bottle is brought in front of the sensor by the conveyor belt, the infrared light emitted from the emitter gets reflected from the bottle, which is then received by the receiver of the sensor. When no object is in front of the transmitter, the receiver does not receive any signal.

2.1.3 Liquid Flow Control Mechanism from Overhead Tank to the Bottle

When the bottle is detected by the photoelectric sensor, the task of filling the bottle with liquid starts. A solenoid valve (Figure 2.1) is used to control the flow of liquid from overhead tank to the bottle. The solenoid valve is positioned at the filling station. When a bottle stops underneath the valve, it gets a command from the PLC to open the valve and liquid flows from the overhead tank to the bottle. The level up to which a bottle should be filled is controlled by a timer of the PLC, i.e., after a certain time period, the timer gives a signal to close the valve. The opening duration of the valve depends on the timer which can be modified easily using PLC software.

2.1.4 Liquid Level Maintaining Mechanism at the Overhead Tank

Our designed overhead tank (Figure 2.2) holds about 1.8 liters of liquid. Due to continuous filling of the bottles, the amount of liquid at the overhead tank gets depleted. So it is crucial to maintain a minimum level of liquid at the overhead tank to continue the smooth operation of the bottle filling task. On the other hand, while refilling the overhead tank with liquid, care should be taken so that it does not overflow. Therefore, the option for sensing the minimum and maximum liquid levels has been provided. Two sensors, i.e., the upper level and the lower level sensors are placed as shown in Figure 2.2. There is also a common node placed below the lower level sensor. The sensors work on the conductivity property of liquid. The common node is connected to the 24 V DC power supply of the PLC module. When liquid

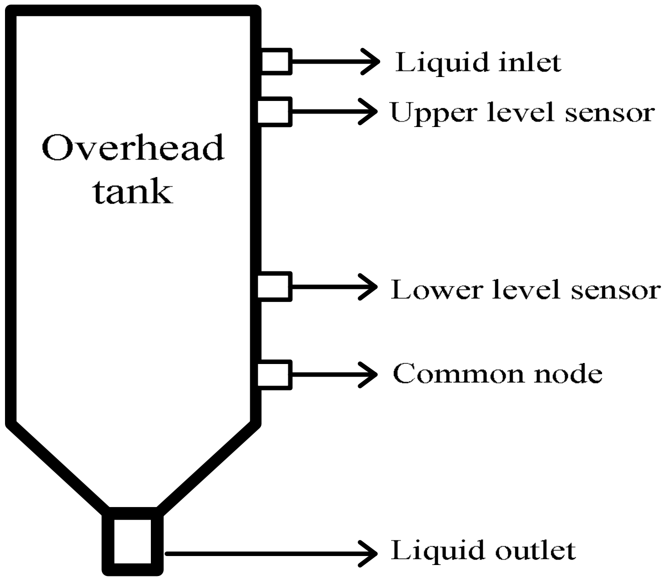


Figure 2.2: Overhead tank

level at the overhead tank goes below the lower level sensor, the circuit between the lower level sensor and common node gets opened and a signal is sensed at the PLC providing the information on inadequate amount of liquid at the overhead tank and consequently a command is sent from the output of the PLC to start a pump to refill the overhead tank from the main reservoir. On the other hand, when the liquid level goes above the upper level sensor, due to the conductivity property of the liquid, a circuit is completed between the upper level sensor and the common node. Consequently, a signal is sensed at the PLC, providing the information on overflow of liquid at the overhead tank. Therefore, a command is sent from the output of the PLC to stop the pump.

2.2 Major Components of the System

The major components used in our project are listed below:

1) PLC module
2) Conveyor Belt
3) Sensor

4) Motors
5) Valve
6) Reservoir

These components are briefly described in the following section.

2.2.1 PLC Module

In our project, to implement the control logic of the system, we used a PLC. Here we have used SIMATIC S7-1200 which is manufactured by Siemens Corporation. This PLC unit is available at the EEE department laboratory of our university. This PLC is manufactured to industrial standards. It's communication with input and output component is fast [2]. In this unit, up to eight additional signal modules can be connected. Figure 2.3 shows the PLC unit that was used in our project.

Figure 2.3: PLC module

There are several models of central processing unit (CPU) available with different models of SIMATIC S7-1200. The PLC in our lab has the CPU model number 1214C. It is a compact high performance CPU, and has an integrated power supply of 24 V DC, 14 integrated digital inputs and 10 integrated digital outputs. It also has 2 analog inputs, 50 KB work memory and 2 MB of load memory which is expendable to 24 MB using Siemens memory card. The maximum current consumption (at 24 V DC) per input is 4 mA, and the maximum current available (at 24 V DC) per output pin is 400 mA. The power supply module is used to provide 24 V DC stabilized power to the SIMATIC S7-1200. Its input is 120/230 V AC and output is 24 V DC and 2.5 A [2].

2.2.2 Conveyor Belt

The conveyor belt (Figure 2.4) we used has two layers, the outer layer is made of rubber and the inner layer is made of woven fabric with wrap and weft which is also known as carcass [3]. The material for the conveyor belt that we used is of industrial standard. It is about 2.5 feet long and 4 inch wide. Its thickness is about 2 mm.

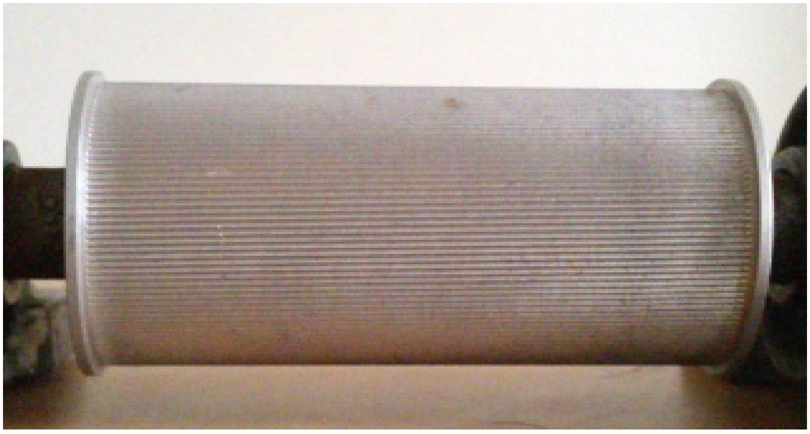
Figure 2.4: Conveyor belt

Steel Panel: The steel panel (Figure 2.5) has two rollers on which the conveyor belt rests. The panel is 3 feet long and about 7 inches wide. To adjust the tension of the conveyor belt, an adjustment screw is used to adjust the roller on one side while the other roller is kept fixed.

Figure 2.5: Steel panel structure

Rollers and Bearings: Figures 2.6, 2.7 and 2.8 show the rollers and the bearings. The bearings act as the supports for the rollers, and enable the rollers to rotate smoothly. The diameter of the rollers that we used is about 2 inches. Of the two rollers used to roll the conveyor belt, one roller has a smooth surface, while the other has a roughed surface to avoid the belt from slipping over the rollers.

(a)



(b)

Figure 2.6: Rollers with (a) smooth surface (b) rough surface

Figure 2.7: Bearing

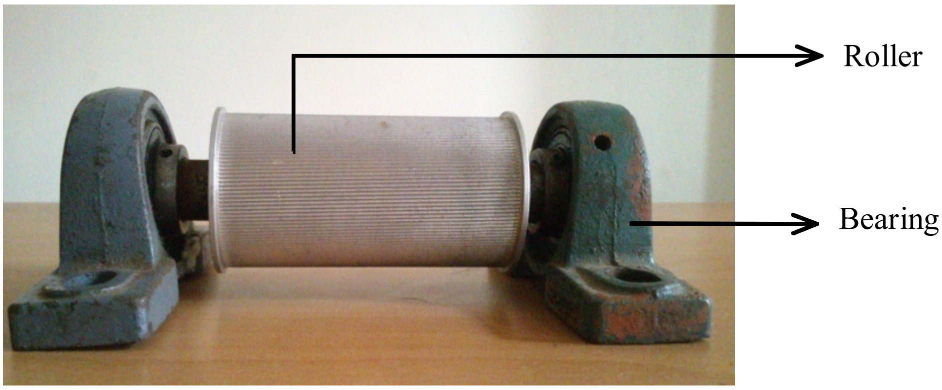


Figure 2.8: Roller with bearing

The two rollers also have of raised of about 2 mm edges on both sides which act as barriers to prevent the conveyor belt from sliding along the rollers horizontally.

2.2.3 Sensor

In our project we have used two kinds of sensors. These are (1) photoelectric sensor and (2) liquid level sensor.

(1) Photoelectric sensor:

Figure 2.9 shows the photoelectric sensor used in our project to detect the arrival of a bottle at the filing station [4]. The photoelectric sensor acts as a non-contact object detector. The photoelectric sensor is cylindrical and its diameter is 18 mm. The operating voltage is 10-30 V DC.

Figure 2.9: Photoelectric sensor

The photo-electric sensor actually uses the target as the "reflector", such that detection occurs upon reflection of the light off the object back onto the receiver [5].

(2) Liquid level sensor:

For sensing the level of liquid in the overhead tank, we made a sensor ourselves. It uses the electricity conducting property of liquids. We used three nodes to sense the level of liquid, (a) the upper level node, (b) the lower level node, and (c) the common node. The common node is connected to one end of a 24 V DC supply. These sensors are basically S.S. nut bolts which are wired in such a way that, when the liquid in the tank is in contact with the common node and any other (upper/lower level) sensors, an electrical circuit is completed. This condition is detected by the PLC to understand whether the overhead tank is low in liquid, or has sufficient liquid.

2.2.4 Motors

In our project we used two types of motors, one is DC gear motor to drive the conveyor belt, and the other is DC motor which acts as a liquid pump.

(1) DC gear motor:

Figures 2.10 and 2.11 show the DC gear motors used in our project. A DC gear motor is a type of DC motor that has a gear assembly attached to the motor [6]. As a result, the motor can run at a high torque and can carry heavy loads.

Figure 2.10: DC gear motor front side view

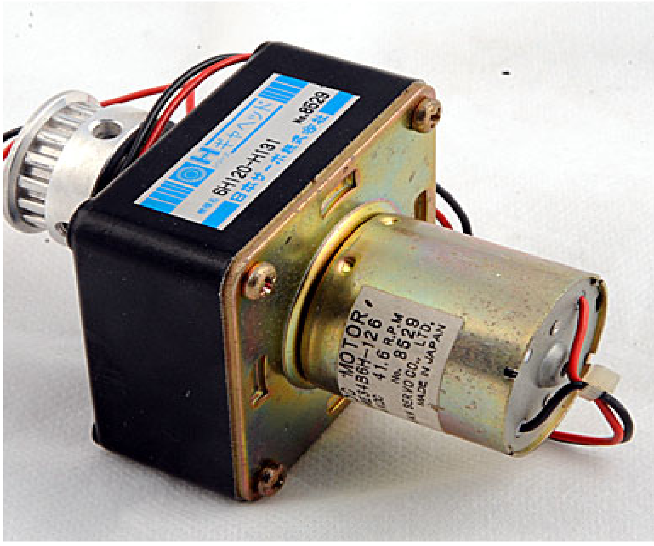


Figure 2.11: DC gear motor back side view

The operating voltage of motor is 24 V DC that can drive up to 15 kg of load with maximum output speed of 41.6 rpm. It draws about 1 A current.

DC motor pump:

Figure 2.12 shows the DC motor with pump assembly used in our project. This motor has a pump assembly attached to it to pump liquids.

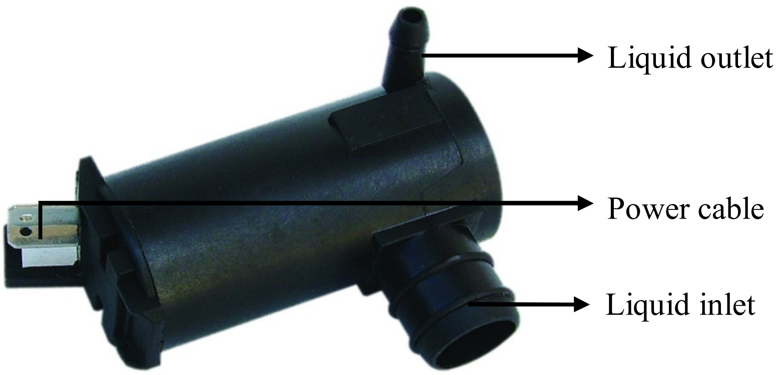


Figure 2.12: DC motor pump

The motor used in our project is rated at 12 V DC and draws about 3.5 A current. Since it was difficult to make a light weight pump assembly needed for our project, we used a motor pump which is used in cars to supply water on the car's front glass and known as wiper washer pump [7].

2.2.5 Solenoid Valve

A valve is a device that controls the flow of liquid. It can be opened and closed to control the flow of fluid. Valves can be hydraulic or electrical. In a hydraulic valve, the valve opens or closes depending on the liquid or air pressure. In electrical valves, an electric signal is used to open or close the valve.

In our project we used a solenoid valve (Figure 2.13) that operates by electric signal [8]. When it receives an electrical signal, the valve is opened, otherwise it is left closed.

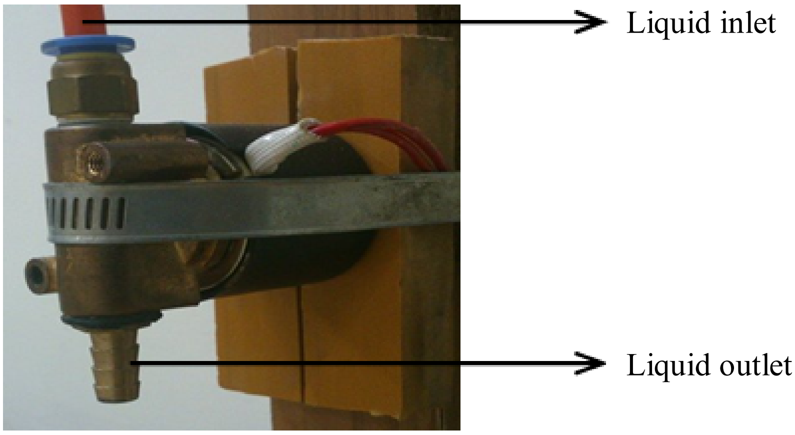


Figure 2.13: Solenoid valve

The solenoid valve that is used in our project operates at 220 V AC. As PLC configuration has 24 V DC output, we used relay for switching in order to provide 220 V AC. It has a pipe that is connected with overhead tank.

2.2.6 Reservoir

Our project consists of an overhead tank and a main reservoir.

Overhead tank:

We have used a bottle to simulate overhead tank. The overhead tank is situated at a vertical distance from solenoid valve. It has a pipe connected with the solenoid valve. The overhead tank passes liquid through the solenoid valve to fill bottles. It takes up to 45 seconds to fill the overhead tank used in our project, which can hold up to 1.8 liters of liquid. The electrical liquid level sensing system is incorporated in the overhead tank. The sensing system operates on 24 V DC. The system allows maintaining the level of liquid in the overhead tank which is very important to continue bottle filling.

Main Reservoir:

A five liter plastic pail is used as a main reservoir in our project. It is situated at ground. It has a pipeline connection with the overhead tank through a DC motor pump. The DC motor pump extracts liquid from main reservoir to overhead tank through pipeline. It takes 45 seconds to fill the overhead tank.

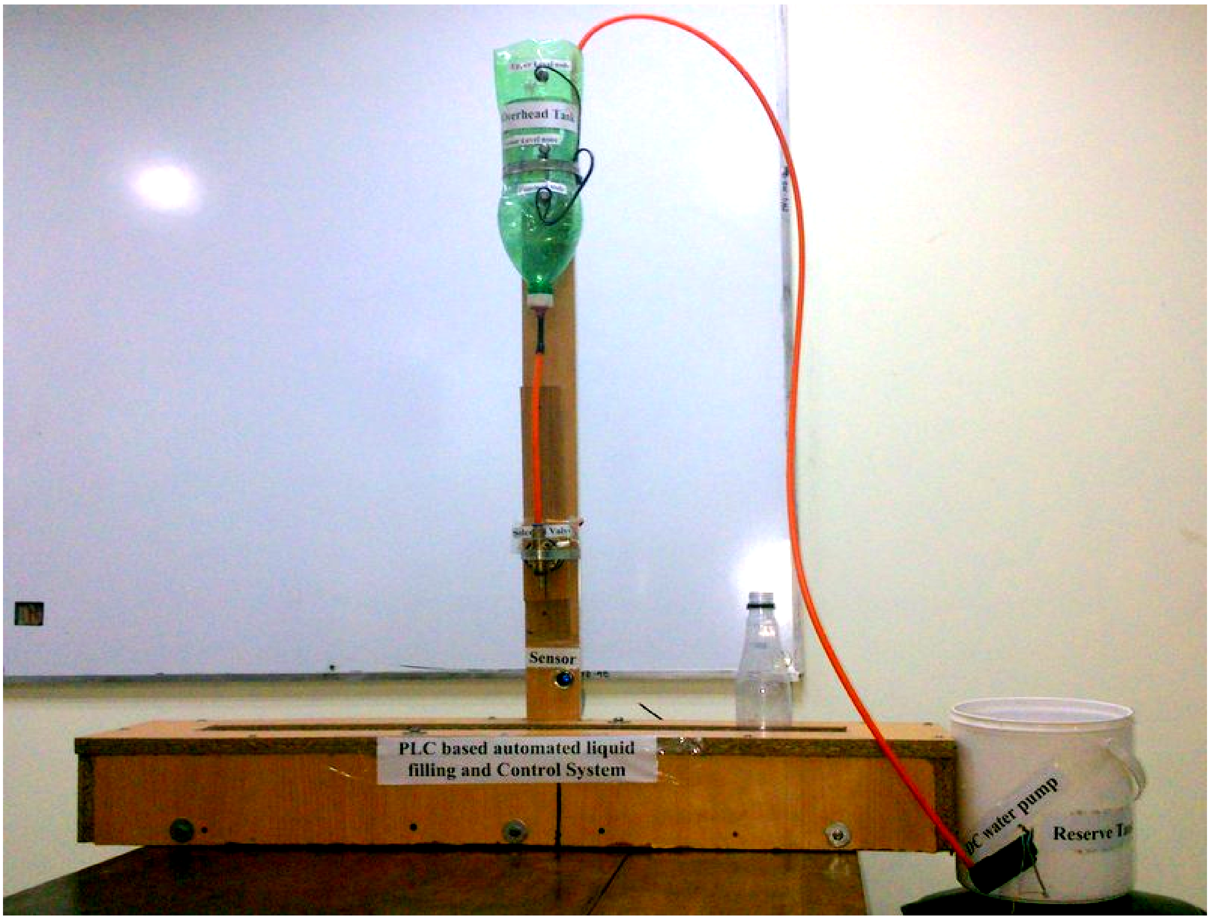


Figure 2.14: PLC controlled automatic bottle filling system

Figure 2.14 shows the complete PLC controlled automatic bottle filling system.

Chapter 3

Software

To control a process using PLCs, it is required to program the PLC according to the desired control logic. One of the reasons for PLCs gaining so much popularity is that, they can be programmed using simple and intuitive programming technique. In our project, we used ladder diagrams to implement the control logic.

Every PLC manufacturer provides their own software interface to program the PLCs. The software provided by Siemens Corporation is named ‘Simatic Step-7 1200’. This software is user friendly and provides efficient functions for configuring and programming the PLC using ladder diagram.

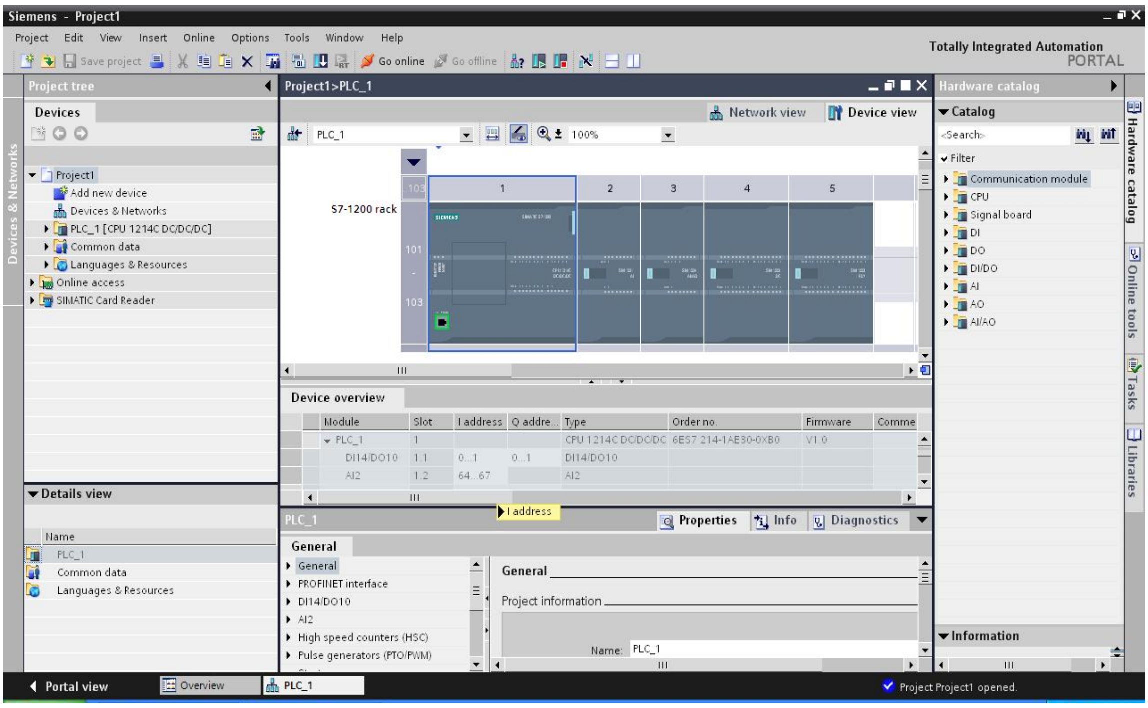


Figure 3.1: Totally Integrated Automation Portal

Before control logic is programmed into the PLC, it needs to be configured in the software. After configuration, the ladder diagram is constructed and simulated to control the liquid filling system.

3.1 Flow Chart for Bottle Sensing and Filling System

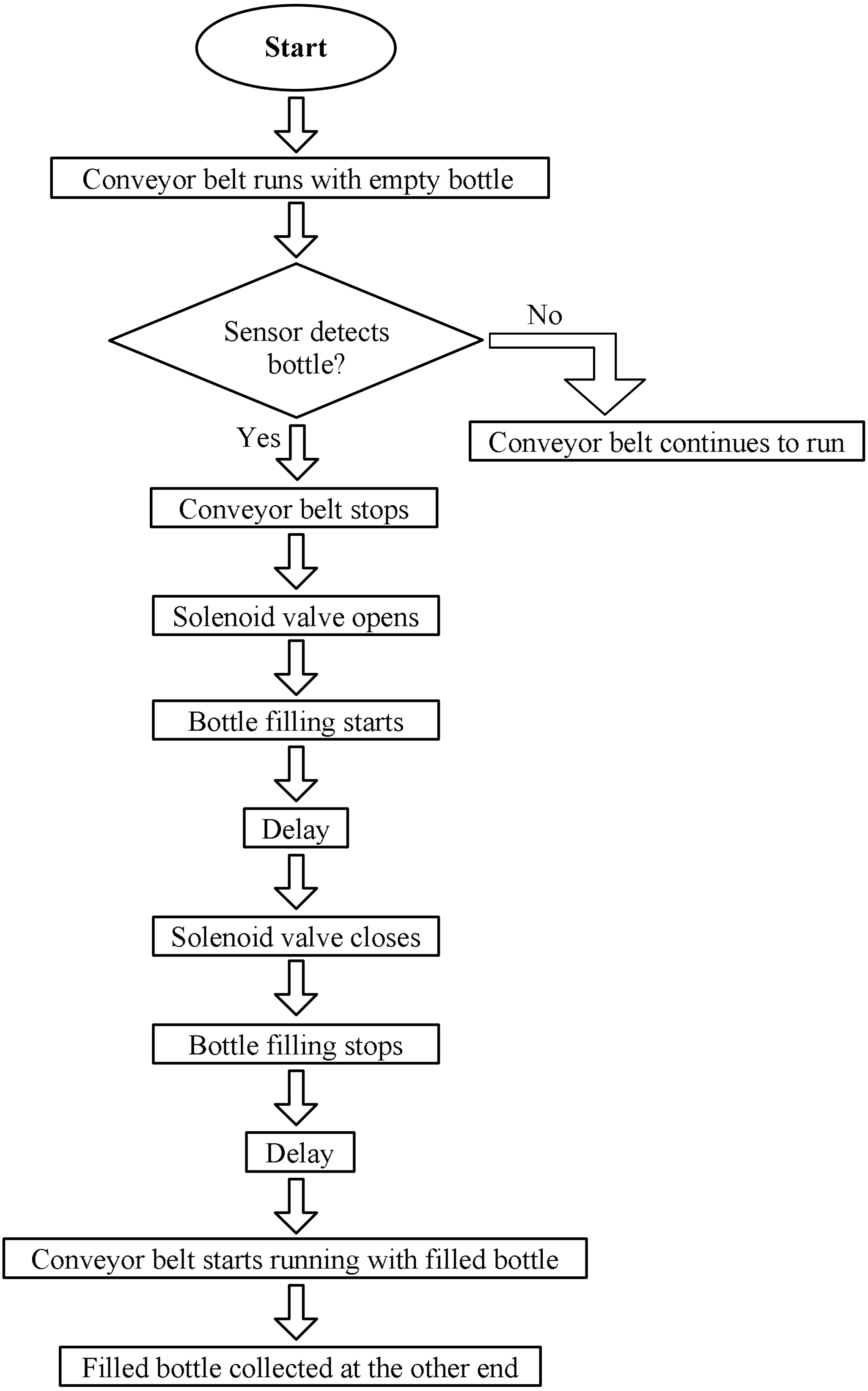


Figure 3.2: Flow chart for bottle sensing and filling system

Figure 3.2 shows the flow chart of the bottle sensing and filling system. When the system is powered on, the conveyor belt starts running. The conveyor belt keeps running if the photo electric sensor does not detect the presence of any bottle in front of it. If the sensor detects any bottle then the conveyor belt stops, solenoid valve opens and bottle filling starts. We control the amount of liquid filling with a timer. Depending on the timer's time duration, the opening of the valve is decided. The solenoid valve then closes and after some time delay conveyor belt starts again with the filled bottle and carries the bottle to the other end where the bottle is collected by an attendant.

3.2 Flow Chart for Maintaining Liquid Level at the Overhead Tank

Figure 3.3 shows the flow chart of liquid level control at the overhead tank. As we need to control the liquid level at the overhead tank, leveling sensors are used. When the liquid goes below lower level, the DC motor starts pumping liquid from the main reservoir to the overhead tank. When the liquid touches upper level, DC motor pump stops to prevent overflow of liquid at the overhead tank. If the liquid doesn't touch the upper level, the DC motor pump remains on.

3.3 Ladder Diagram for the System

The ladder diagram (LAD) of the PLC controlled automated bottle filling system is shown in Figure 3.4. We have used both "Normally Open" and "Normally Close" type LAD contacts [2] which correspond to the physical contact signals from different sensors of our project and are directly wired to the "*I*" (input) terminals on the PLC. The "Normally Open" contact is closed (ON) when the assigned bit value at its address is equal to 1 and the "Normally Close" contact is closed (ON) when the assigned bit value at its address is equal to 0. These LAD contacts use the memory identifier "*I"* and bit value is read from the process image register. The PLC system scans the wired input signals and continuously updates the corresponding state values in the process-image register. We have used different combinations of the LAD contacts to implement the control logic of the project.

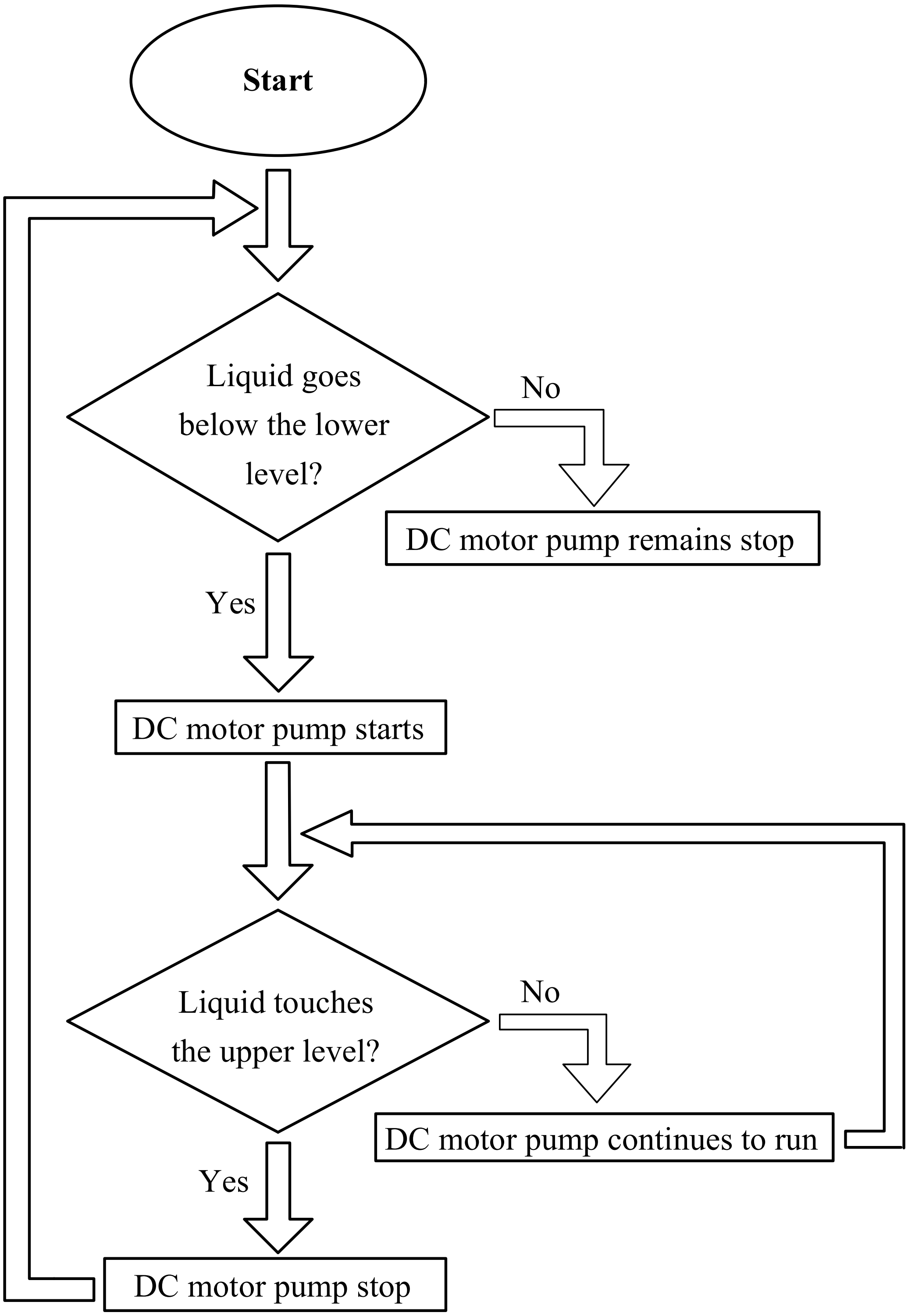


Figure 3.3: Flow chart for maintaining liquid level at the overhead tank

Several LAD output coils have also been used, which contain the memory identifier "*Q*". The output signals for the actuators and valves are wired to the "*Q*" terminals of the S7-1200. In RUN mode, the CPU system continuously scans the input signals, processes the input states according to the program logic, and then reacts by setting new output state values in the process-image output register. Although "Normal" and "Inverted" type output coils are available, we have used Normal type. If there is power flow through a normal type output coil, then the output bit is set to 1 and if there is no power flow through the output coil, then its corresponding bit is set to 0. After each program execution cycle, the CPU system transfers the new output state reaction stored in the process-image register to the wired output terminals.

Moreover, we needed to use "pulse timer (TP)" as well as "On-delay timer (TON)" to create programmed time delays. The pulse timer generates a pulse with a preset width time and the On-delay timer output is set to ON after a preset time delay. Each timer uses a structure stored in a data block to maintain timer data.

Figure 3.4 shows the ladder diagram of our program. The control logic implemented through each of the rungs of the ladder diagram has been explained below.

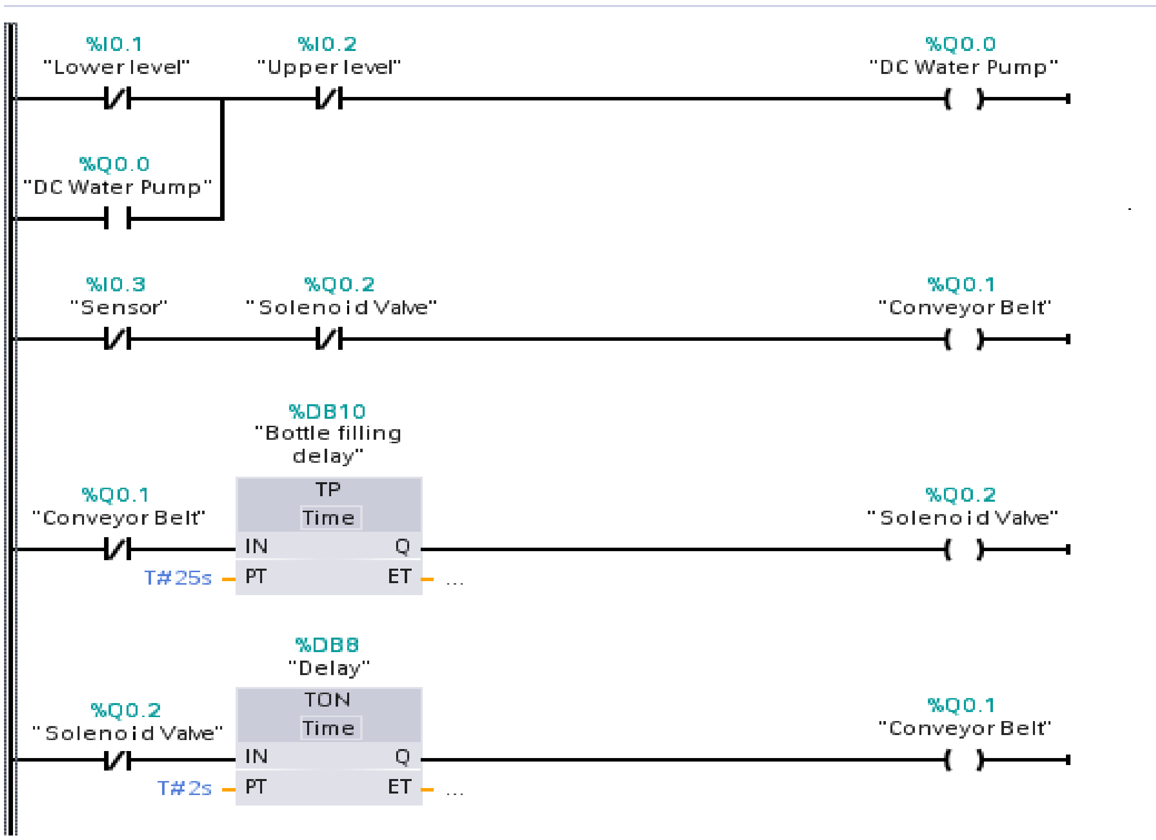


Figure 3.4: Ladder diagram

- The lower and upper level sensor outputs are connected to the input ports of the PLC with addresses *I0.1* and *I0.2* respectively. The first rung of the ladder diagram indicates that both *I0.1*and *I0.2* LAD contacts are normally closed type that enables the DC pump (*Q0.0*) to operate as long as the upper level sensor does not come in contact with liquid. When the liquid level in the overhead tank crosses the upper level sensor the LAD contact addressed *I0.2* breaks.
- The second rung indicates the control logic to stop the conveyor belt. The conveyor belt continues to run as long as both the photoelectric sensor output and solenoid valve status stored at the bit addresses "*I0.1*" and "*Q0.2*" respectively is low. If either one of the bit logics in these addresses becomes high the conveyor belt stops. This situation occurs if the photoelectric sensor detects the presence of the bottle or if the solenoid valve is open
- The third rung shows the control logic to open or close the solenoid valve. The solenoid valve opens on the condition that the conveyor belt is in stop position and it remains open for 25 seconds as set by the TP timer.
- The control logic at the fourth rung ensures that the conveyor belt does not start running again as soon as the solenoid valve gets closed. A delay of 2 seconds has been introduced by a TON timer to ensure that there is no spill over of the liquid on the conveyor belt.

Chapter 4

Hardware Construction

There are several hardware components in the system. Most of the components had to be custom made due to lack of availability of components at the local market. Our project required the construction of the conveyor belt, the filling station (with the liquid level sensing mechanism of the overhead tank and the solenoid valve) and the main reservoir (with DC motor pump and pipelines).

4.1 Construction of Conveyor Belt

The steel panel (Figure 4.1) is made up by attaching four steel angles with wielding machine. A small angle is also welded with the main panel that supports the DC electrical motor. Holes are drilled in the panel to place the bearings for the rollers.

Figure 4.1: Steel panel

Figure 4.2: Steel panel with fixed roller

Figure 4.3: Steel panel with fixed roller & horizontally adjustable roller

Figure 4.4: The complete conveyor belt with elements

The two rollers are put at a distance with each other to keep the conveyor belt taut. As mentioned in chapter 2, there are two rollers, one of which can be moved horizontally to adjust the tension of the conveyor belt (Figures 4.1, 4.2, 4.3 and 4.4). The conveyor belt is placed on the two rollers with a melamine board guide. Finally, it is covered with a melamine board structure.

The frame (Figure 4.5) is constructed for the safety of conveyor belt. It also helps to allign

Figure 4.5: Frame for conveyor belt

the bottles carried by the conveyor belt. Different pieces of melamine boards are attached with steel panel using screws and nut bolts.

Conveyor belt motor connection:

The conveyor belt has a DC gear motor of 24 V. The DC gear motor (Figure: 4.6) is placed with the roller in such a way that the motor is able to revolve the roller. The 24 V is supplied from PLC I/O port module. The DC gear motor has two wire; red and black. The red colored wire is connected to the PLC output module and black wire is connected to the ground.

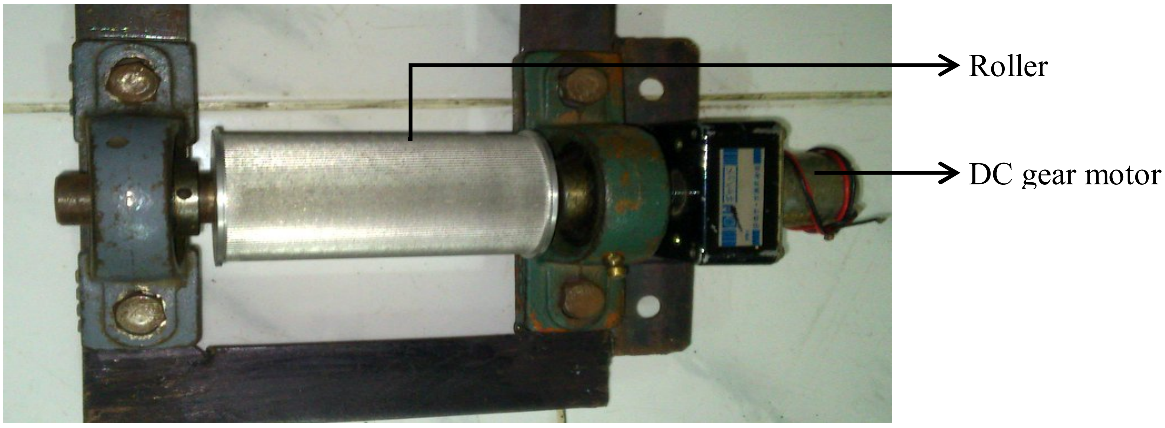


Figure 4.6: DC gear motor with roller

4.2 Construction of the Filling Station

A long melamine structure (Figure 4.7) is placed vertically with the help of a steel panel. The solenoid valve and the overhead tank are attached firmly with the melamine structure using adjustment screws.

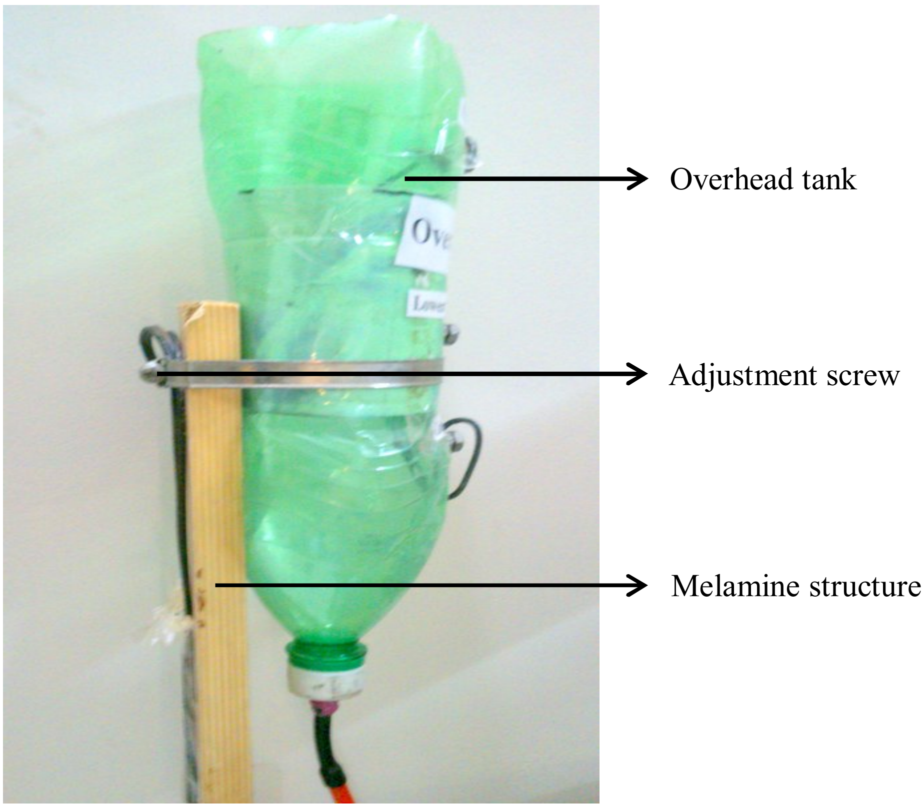


Figure 4.7: Overhead tank placement

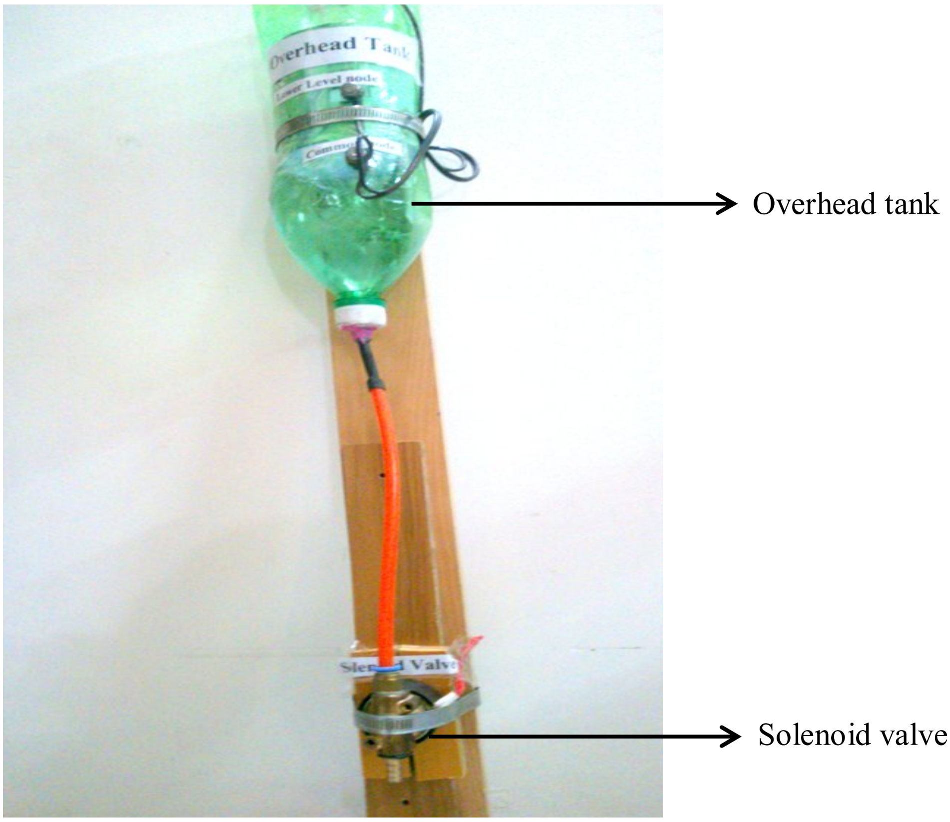


Figure 4.8: Overhead tank with solenoid valve

Figure 4.8 shows the solenoid valve attached to the overhead tank with pipes.

Photoelectric sensor connection:

The connection diagram of photoelectric sensor wiring is given in Figure 4.9.

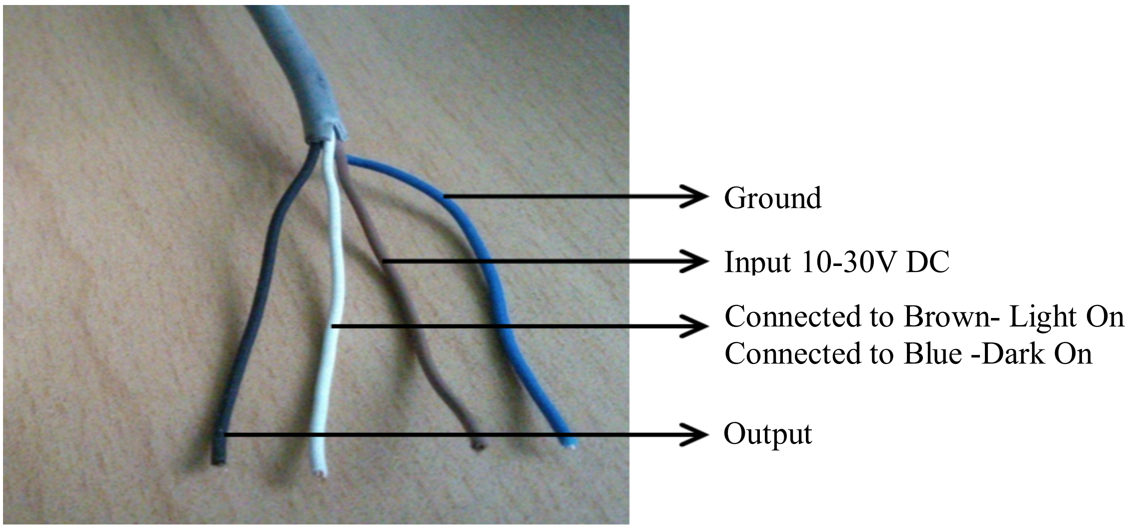


Figure 4.9: Connection diagram of photoelectric sensor

From the Figure 4.9 we see that, the sensor has three inputs (blue, white and brown) and one output (black). There are two types of connection of the sensor: light on and dark on. If a sensor output is high while no light is received at the sensor then this is called a dark-on output. On the other hand, if the output is on while the receiver detects the light from the emitter, the sensor would have a light-on output [4]. But we have used only light on for connection. The black colored wire is the output that contributes 200 mA to the PLC input. In the presence of object the sensor's input (which 10-30 V DC) is switched to output.

In our project, the photoelectric sensor operates at 24 V. The sensor is mainly connected to the PLC input port and power supply module. The sensor input blue is grounded and other two inputs white and brown are connected to the 24 V DC supply of the PLC module. The sensor output black (wire) is connected to the PLC input port module. When bottle comes in front to the sensor the sensor sends a signal to the PLC input port to give the information of the bottle's presence.

Liquid level sensing:

Liquid level sensing is made up with three nut bolts in a 2 liter bottle hanged upside down and attached with melamine stand as an overhead tank (Figure 4.10). The three nut bolts are heated and screwed into three levels of overhead tank.

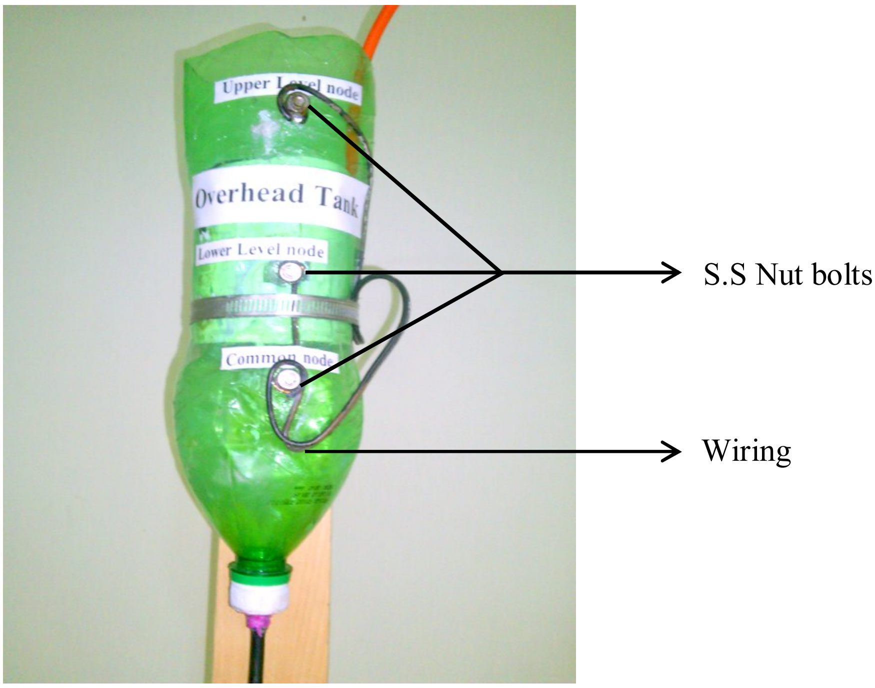


Figure 4.10: Liquid level sensing components

The three nut bolts are considered as three nodes; common node, lower level node and upper level node. The nut bolts are wired and connected with PLC module for sensing.

Solenoid valve connection:

Figure 4.11 shows the solenoid valve used in our project. The solenoid valve operates at 220 V. But the PLC I/O port module can only supply 24 V. So a relay is used as a switch to operate the valve at 220 V AC.

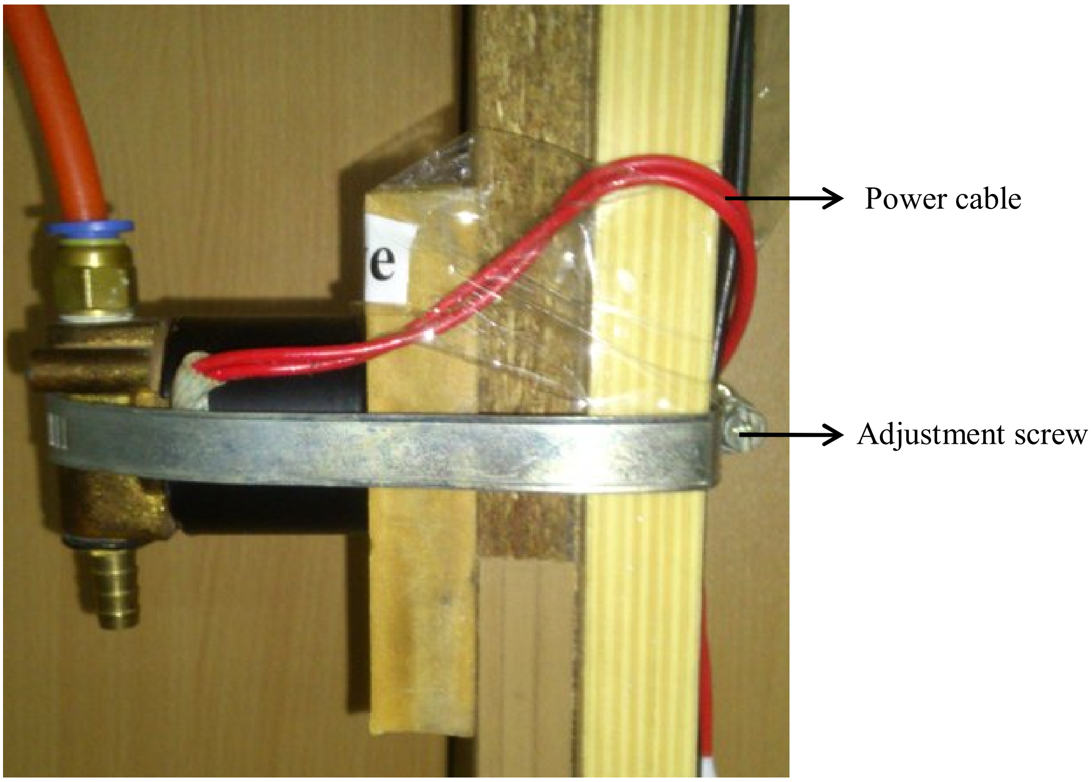


Figure 4.11: Solenoid valve

The switching is done from the PLC output port module. When the photoelectric sensor sends a signal to the PLC input module, the PLC module also gives a corresponding output to the PLC output module for switching the relay.

4.3 Construction of Main Reservoir with DC Motor Pump

The main reservoir (Figure 4.12) is placed at a distance from the conveyor belt. Beside the main reservoir at ground level, a DC motor pump is screwed tightly into the reservoir.

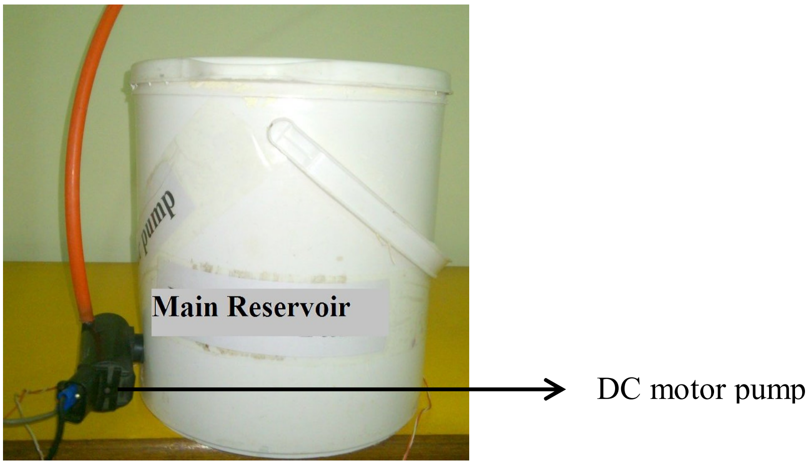


Figure 4.12: Main reservoir with DC motor pump

There are two pipelines in the system (Figure 4.13). One is the pipeline connection between the solenoid valve and the overhead tank. The other is the connection between the overhead tank and the main reservoir.

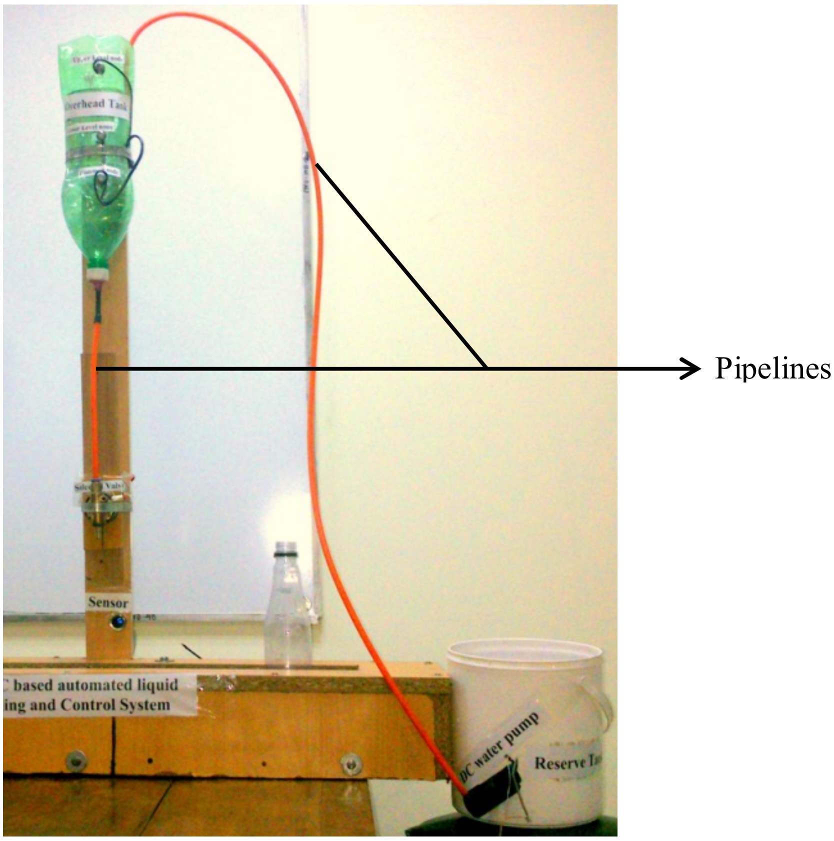


Figure 4.13: Pipelining

Chapter 5

Conclusion

We built a PLC controlled automatic bottle filling system. PLC based automated liquid filling and control system is a part of industrial production system. This system is suitable for liquid production where we need certain amount of liquid. The automated liquid filling process is operated in such a way that it saves both time and cost.

Actually this project has both mechanical and electrical part. The mechanical part of the project required drawing of the mechanical system; welding and fabricating process. The electrical part consisted of electrical wiring, programming and some other electrical methods. As a result we have gained knowledge of mechanical system along with electrical system.

It can be said that by doing this project successfully we were able to understand how to the construct industrial systems.

We would like to recommend that a course on mechanical engineering should be added to our course curriculum so that the students can understand and operate mechanical parts easily.

Future Development

Our project involves the filling process of liquid, overhead tank system and the water pump system. But these are only a part of the total system. There are additional operations like bottle capping system, automatic packaging or labeling system, monitoring system etc.

- **Bottle capping system:** This system facilitates the bottle capping after the liquid is filled. A stepper motor operated capper can be used for bottle capping.

- **Robotic arm system:** This system can be used to move and place a bottle to a required position. It can be used in both placing the bottle on the conveyor belt and removing from the conveyor belt to the packaging system.

- **Packaging system:** To box a particular number of bottles the packaging system can be used. This system can be facilitated by the help of robotic hand.

- **Monitoring system:** Several monitoring systems can be placed in this project to monitor the number and sensing of bottle, quantity of liquid in the bottle etc.

It can be mentioned that our country imports the liquid filling machine from abroad. If proper intelligence and funding is provided then we can construct automated machines in our country.

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