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Automatic Bottle Filling, Capping And Labelling System Using Plc Based Controller

Ms. Diptee Patil Department of Instrumentation Engineering
Ramrao Adik Institute of Technology Nerul, Navi Mumbai, India

Abstract: In this paper, a bottle filling, capping and labelling machine is introduced using Programmable Logic Controller (PLC) based controller in automation industry. The main aimof the paper is to design and fabricate a small and a simple system using PLC. The belt conveyor is used for moving the bottle. A dc pump is set on tank to control the flow of water. The position of bottle is detected by proximity sensor so that pump can be functioned at right time. When bottle is under the tank, the pump is started and bottle is filled by water after which capping of the bottle takes place using piston rotation system and then labelling isdone. This machine proposed in this paper is cost effective and it can be used in small scale bottle filling systems such as coffee shops, juice shops and other beverage industries.

Keyword: Automation, Programmable Logic Controller (PLC), Easy technology, Low cost

INTRODUCTION:

Filling is defined as the method in whichliquid is packed into the bottle such as water and other beverages. It can be automated by using Programmable Logic Controller (PLC) or Arduino. Inthe modern world, Programmable Logic Controller (PLC) is used for this purpose. PLC is the major element of the whole process. It is a powerful device to control the production system. It is used as a digital computer to automate industrial activities. It has many input and output unit, a CPU and a memory. It gives output results according to the condition of input. It is prepared for the replacement of relay circuit. The automation process is controlled according to the logics of programmed PLC. For inputs and outputs, PLC has a definite number of connections. The advantages of using PLC are smooth operation, low cost and high filling speed. To improve filling accuracy, it is necessary to apply PLC in automatic filling system.The process is controlled by ladder logic. Filling is controlled by using various automatic liquid filling machine by using arduino to measure volume [3].methods using motor, level sensor, proximity sensor, conveyor belt, PLC, solenoid valve. This system can be made with arduino butflexibility will be less. The arduino programming language is more complex than PLC ladder logic. The PLC ladder logic is symbol based that's why it can be change d easily. Lu, Y.-D., et al developed an automaticbeverage filling machine by using PLC [1]. They used PLC to make the system flexible and to improve production rate. The ladderlogic can be changed easily so they use PLC instead of arduino. Baladhandabany, D.,

et al. have studied on the principle of programmablelogic controller and its importance on automation [2]. This process involves placing bottle on the conveyor and filling the bottle ata time. The purpose of this paper is to explain the process of filling more bottles at a time.For this purpose, stepper motor is used effectively to run the conveyor. It requires lessnumber of sensor and it was cost effective.They have used ladder logic to control the whole system.

M.H. Muhammad Sidik and S.A.Che Ghani have made their paper on They used arduino to control the wholesystem. They also used two solenoid valve

to control the flow of liquid. Qijun Gonget al. developed an automatic liquid filling system by using image technology [4]. Simulink is used to make a simulation model which was used to control the filling system. This computer-based technology reduced the accidents and labor costs. Kunal Chakraborty et. al. developed an automatic bottle plant [5]. This paper describes the fundamental stage of filling and capping method. The objective of this paper is to maintain the filling and capping operation at a time. To perform filling operation, bottles are placed on the conveyor. After completing the filling operation, they used a new set of empty bottles underthe solenoid valve. They used PLC to control the system. Kulkarni, S.L. et. al. developed a PLC microcontroller for bottle filling system [6]. They studied onbeverage as well as medicine in food industry and health care industry. As the demand of beverage and medicine are increasing day by day, filling is required to fill up this requirement. In health care industry, manual filling operation isdangerous. Manual filling in beverageindustry is economical loss. It consumes more time than automatic filling system.To remove these disadvantages, they built up automatic bottle filling machine by using PLC. Kiran, A.R et. al. investigated the principle of PLC and its importance in automation [7]. Theyworked on PLC based automation whichis very important in modern world. They proposed that PLC plays an important role in various industries for mass production with more accuracy and productivity. The engineers make ladder logic to operate PLC. They wanted to apply this micro controller in modernindustries. H Ahuja, et al. developed an automatic filling machine [8]. In this time of industrial revolution, automationis needed to help human being to do various work in industries. The competition among industries is risingday by day with their new products and their brands. In order to keep their product in market and deliver the product timely, automation is essential. They used PLC for this automation purpose. Schwager,A., et al developed automatic bottle filling machine by using PLC [9]. They studied on automation of industrial process which explains the manufacturing steps of automatic system in process development. Itimproves efficiency of filling system. Various elements are needed to control for filling system. They used PLC for this purpose. The goal of this paper explains the execution of industry 4.0 concepts in water refining plant by using PLC. They wanted to meet the market demand in short time by using this research. Silva, J.M et. al. Investigated an automatic foundry plant by using PLC [10]. In this paper, they have explained automation which controls the operating device. It minimized human effort, improved production rate, reliability and flexibility. It is useful for small and medium scale industries. They developed this process by using PLC. This type of industrial automation provides highly economic benefits.

Up to now many researchers studied on bottle filling system by using differenttechniques.

The field of automation had a notable impact in a wide range of industries beyond manufacturing. Therefore, in this study an automated bottle filling system using PLC based

microcontroller is designed and developed. The presentmachines will be that it can fill only a particular type of containers of specific volume and capping the bottle automatically. This machine can used in different industries like medicine, oil, chemical etc.

Materials and Methods

Block Diagram of assembly of the proposed machine is shown in Fig.1.

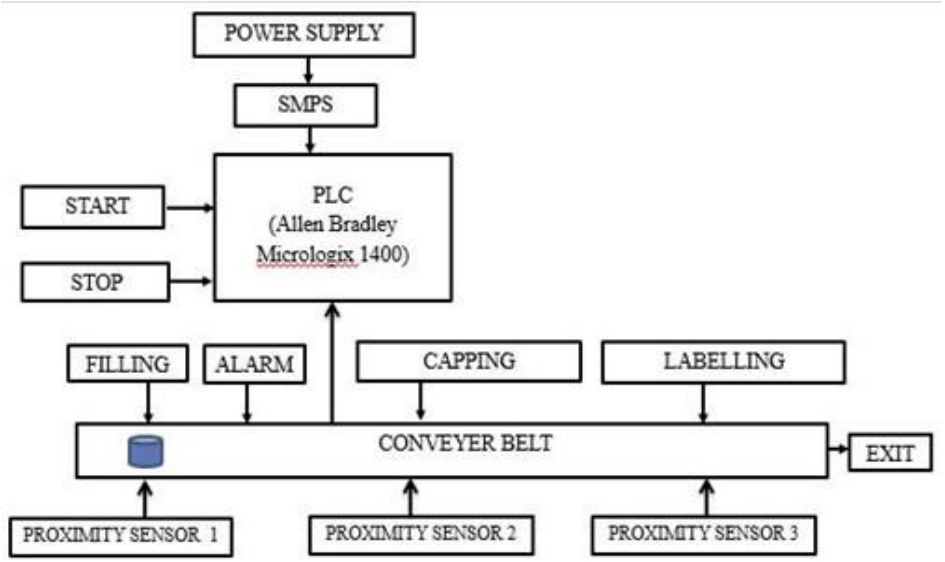


Figure 1: Block Diagram for Assembly of machine

Working Principle

Operator start the process by switching on the START button. As the conveyer belt moves on, bottle reaches to Proximity Sensor 1 where the bottle stops and filling process is implemented. As the filling process is completed the conveyer starts again and as the proximity sensor 2 detects the bottle stops and the capping process is implemented. As the Capping process is completed the conveyer starts again and as the proximity sensor 3 detects the bottle stops and the labelling process is implemented**.**

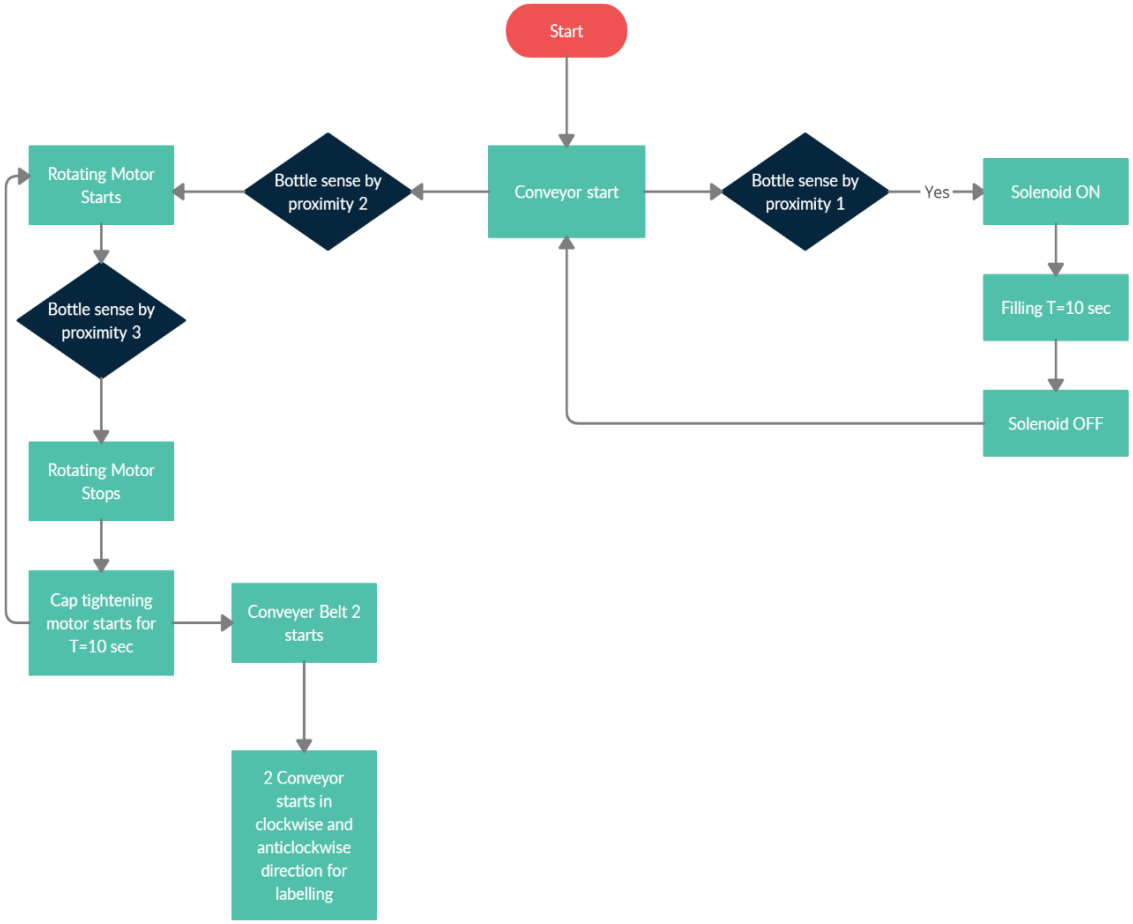
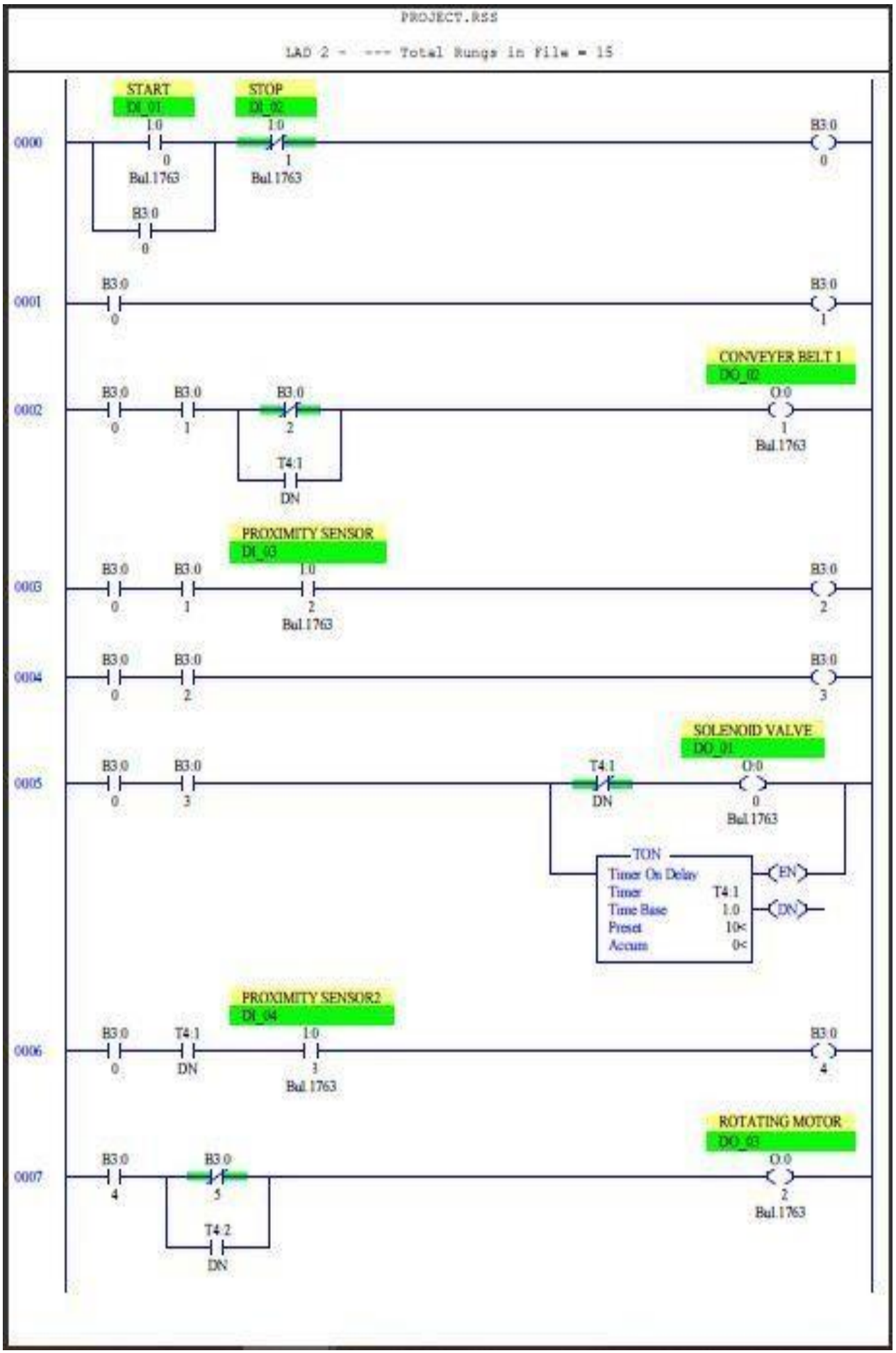


Figure 2: Flow chart of working principle of filling machine


PROJECT.RSS
LAD 2 - --- Total Rungs in File = 15
START
STOP
0000
0001
CONVEYER BELT 1
0002
PROXIMITY SENSOR
0003
0004
SOLENOID VALVE
0005
TON
Timer On Delay
Timer T4:1
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PROXIMITY SENSOR2
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ROTATING MOTOR
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Figure 3: The PLC ladder logic for filling assembly

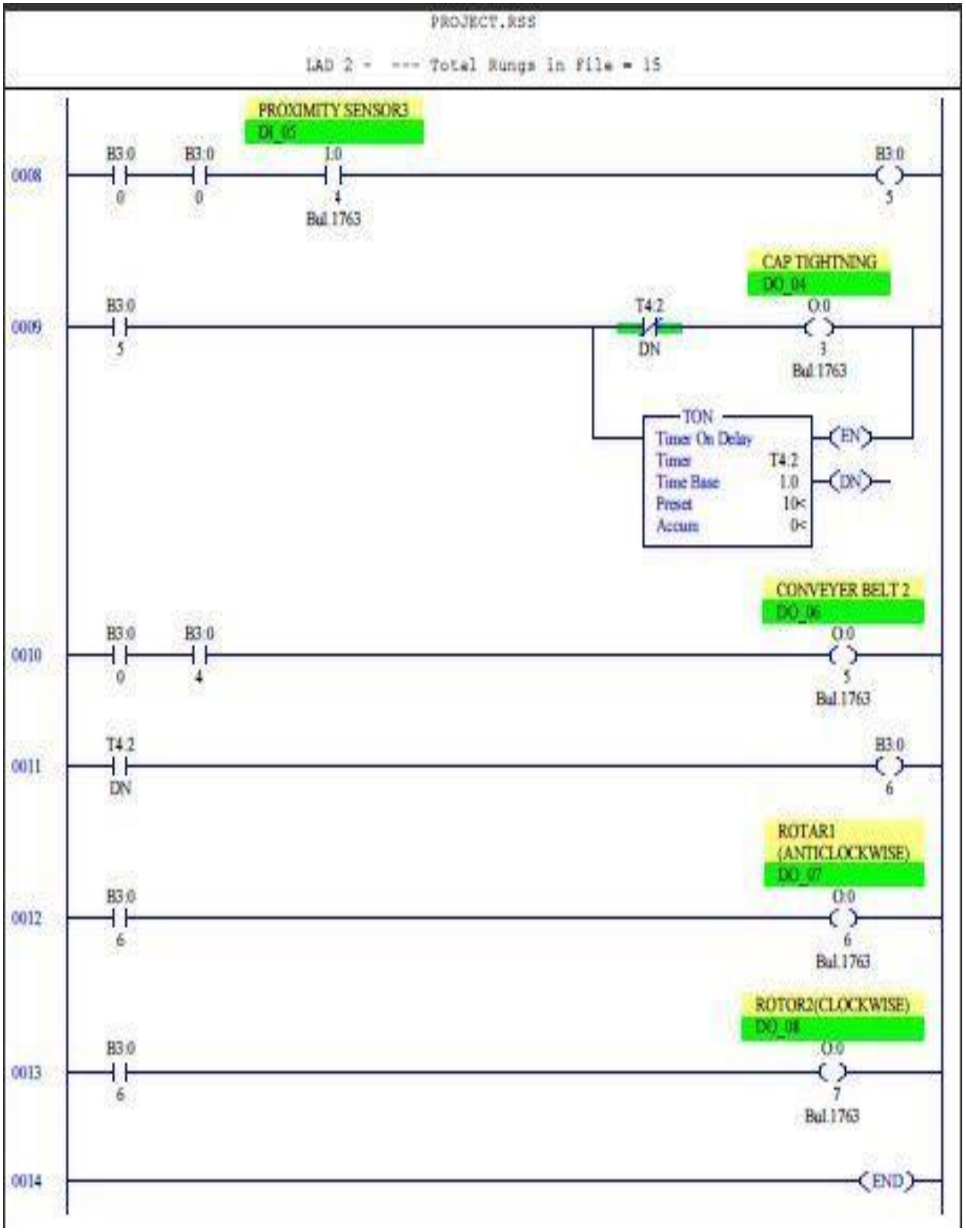

Figure 4: The PLC ladder logic for capping and labeling assembly

Components used

Proximity Sensor

PLC

Solenoid valve

DC Motor

Conveyor Belt

Figure 5: Different components used to construct the filling machine

Programmable Logic Controller (PLC): Programmable logic controller is a microprocessor based to store instructions and logics. In this project, PLC is usedinstead of arduino because it is more convenient to use PLC than arduino.Again, more flexible and more reliable operations can be performed by using PLC. The change of program is so much difficult in arduino micro controllerwhereas PLC ladder logic can be changed very easily if necessary.

Proximity Sensor: A proximity sensor isa sensor capable of detecting, without any physical touch, the presence of nearby objects. A proximity sensor also emits an electric field or electromagnetic radiation beam (for example, infrared) and looks for field or return signal changes radiation beam (for example, infrared) and looks for field or return signal changes.

Belt Conveyor: Conveyor is material handlingequipment. It is used in mechanical sector for moving material from one place to another place. In this project, cotton belt is used because it is of low cost and more flexible.

Solenoid Valve: The function of the solenoid valve requires either opening or closing an orifice in the valve body, which either helps or prevents the valve from flowing through. By energizing the coil, a plunger opens or closes theorifice by lifting or lowering it inside a sleeve tube. Solenoid valves consist of the assembly of a coil, plunger and sleeve.

between moving parts. In this project, ball bearing is used to decrease rotational frictionand to carry radial or axial loads. It is used tocarry the bulk load.

Brushless DC motor: Brushless DC motoris also called as synchronous motor as shownin figure 10. It is operated by direct currentwhich is inverted from alternating current byan inverter. The merits of this motor are high speed, electric control etc. In this project, thismotor is used to control speed manually

RESULTS AND DISCUSSIONS

Final Construction

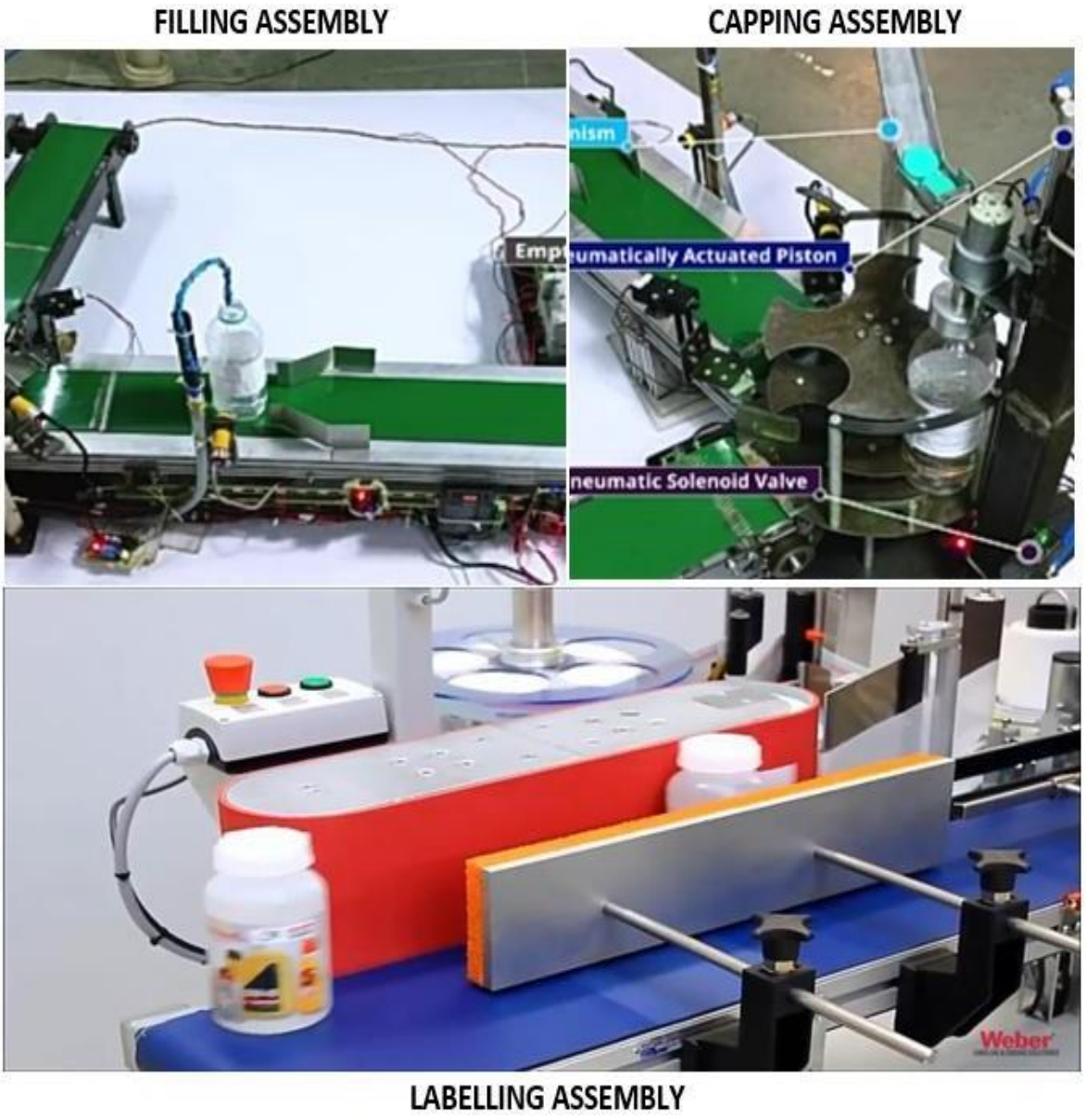

Figure 6: Final Construction of an automatic bottle filling machine

The filling head is responsible for filling of bottles with water or any other product. The system makes use of filling using piston and syringe arrangement. As proximity sensor gives output/signal, Solenoid Valve will open for required time. As timer is off the conveyor beltpush

the bottle towards capping station. will berepeated if another bottle is sensed. The capping head is responsible for spinning and tightening the cap on bottles.
Output/signal of second proximity sensor the disc motor will start rotating. After third proximity sensor disc motor will stop and piston will come down and dc motor will tightthe cap on bottle. As this process complete thedisc motor will rotate and push towards labeling station.
The labeling head is responsible for giving a name or identification label on bottle. a proximity sensor gives signal or output, the two-dc motor start rotating and one side of sticker will stick on bottle. After this labelingconveyor motor will start and sticker will stickon bottle. After this step, the assembly pushesthe bottle over to the next point where it is rolled down the system as a finished product.

CONCLUSION

In this paper the hardware and software of project for an automatic bottle filling machine is designed and constructed. It can be used to fill 200 ml bottle. It is a time based control system and shows someadvantages over traditional filling process. This proposed filling machine is cost effective. It saves human effort and time. It can be used in small scale bottle filling systems such as coffee shops, juice shops and other beverage industries.

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