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Automatic Bottle Filling, Capping and Labelling Using Alarm Management System

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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 aim of 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 to 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. Then capping of the bottle takes place using piston rotation system and then labelling is done. All the components perform well. This machine 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, Easy technology,Low cost and smooth operation.

INTRODUCTION

Filling is defined as the method in which liquid is packed into the bottle such as water and other beverages. It can be automated by using Programmable Logic Controller (PLC) or Arduino. In the 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 tothe 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 definitenumber of connections. The advantages ofusing 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 iscontrolled by using various methods usingmotor, level sensor, proximity sensor, conveyor belt, PLC, solenoid valve. Thissystem can be made with arduino butflexibility will be less. The arduinoprogramming language is more complexthan PLC ladder logic. The PLC ladderlogic is symbol based that's why it can be changed easily. Lu, Y.-D., et al developed an automatic beverage filling machine byusing PLC [1]. They used PLC to make the system flexible and to

improve production rate. The ladder logic can be changed easilyso they use PLC instead of arduino. Baladhandabany, D., et al. have studied on the principle of programmable logic controller and its importance on automation[2]. This process involves placing bottle on the conveyor and filling the bottle at a 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 less number of sensor and it was cost effective. They have used ladder logic to control the whole system.

Materials and Methods

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

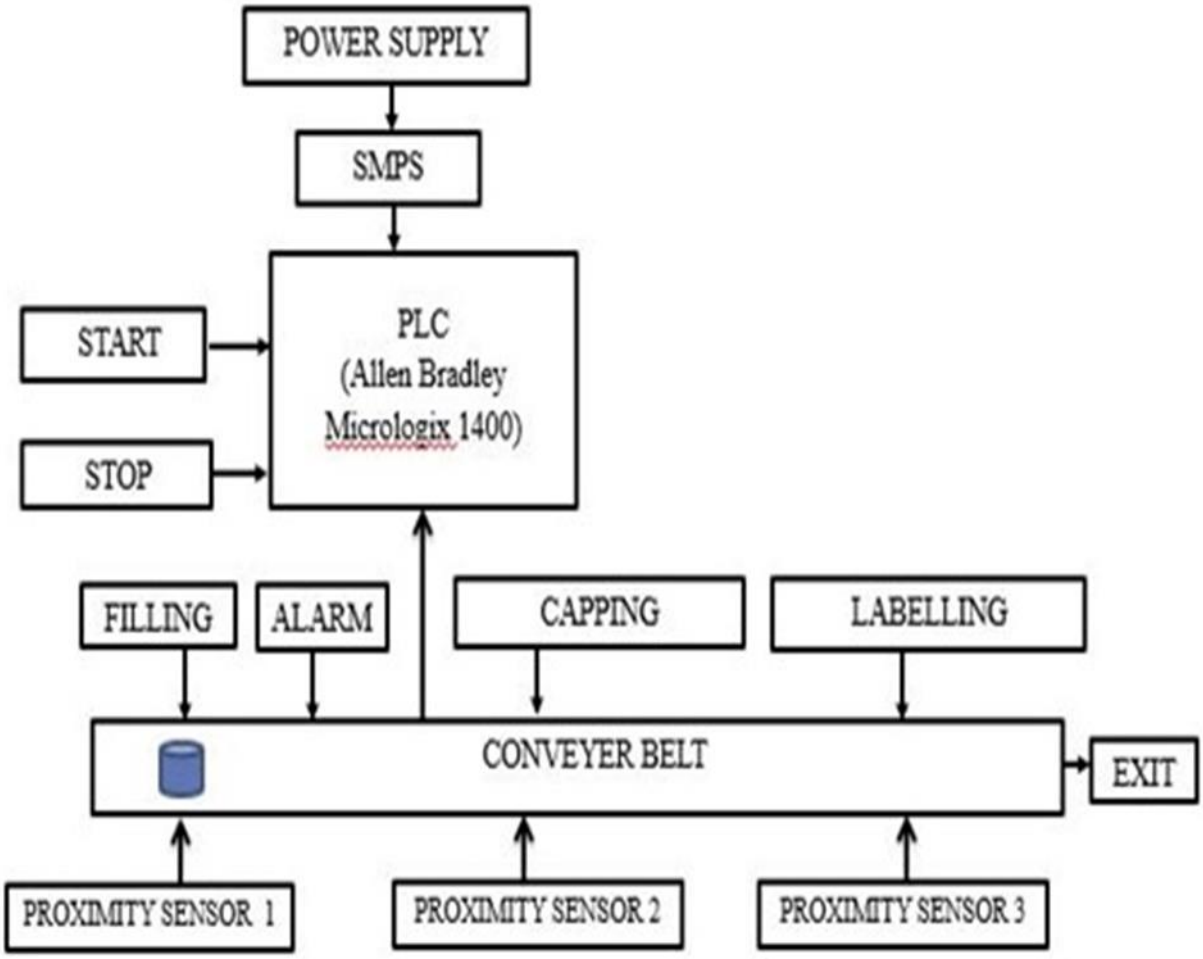


Figure 1: Block Diagram for Assembly of machine

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 startsagain 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**.**

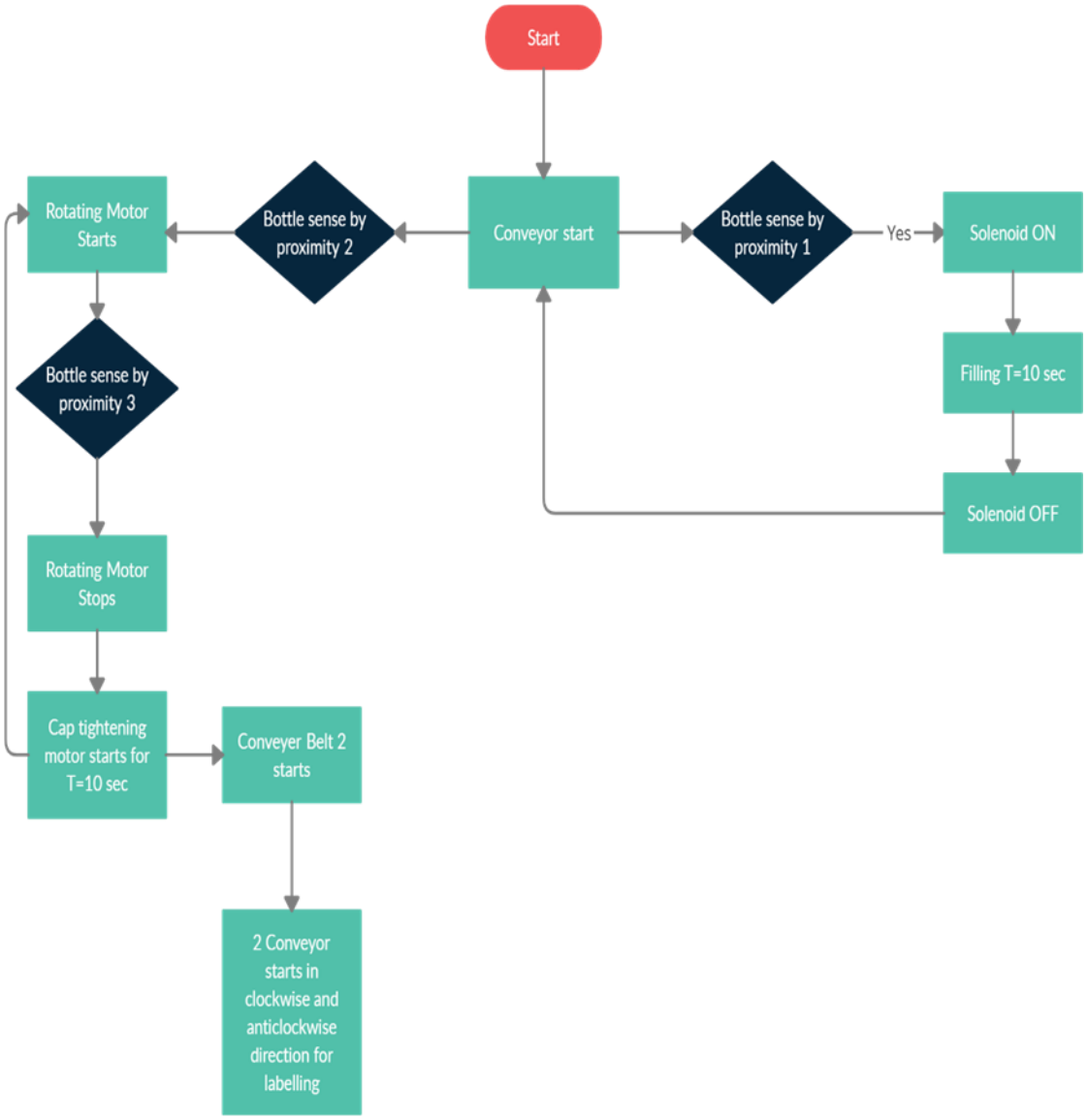


Figure 2: *Flow chart of working principle of filling machine*

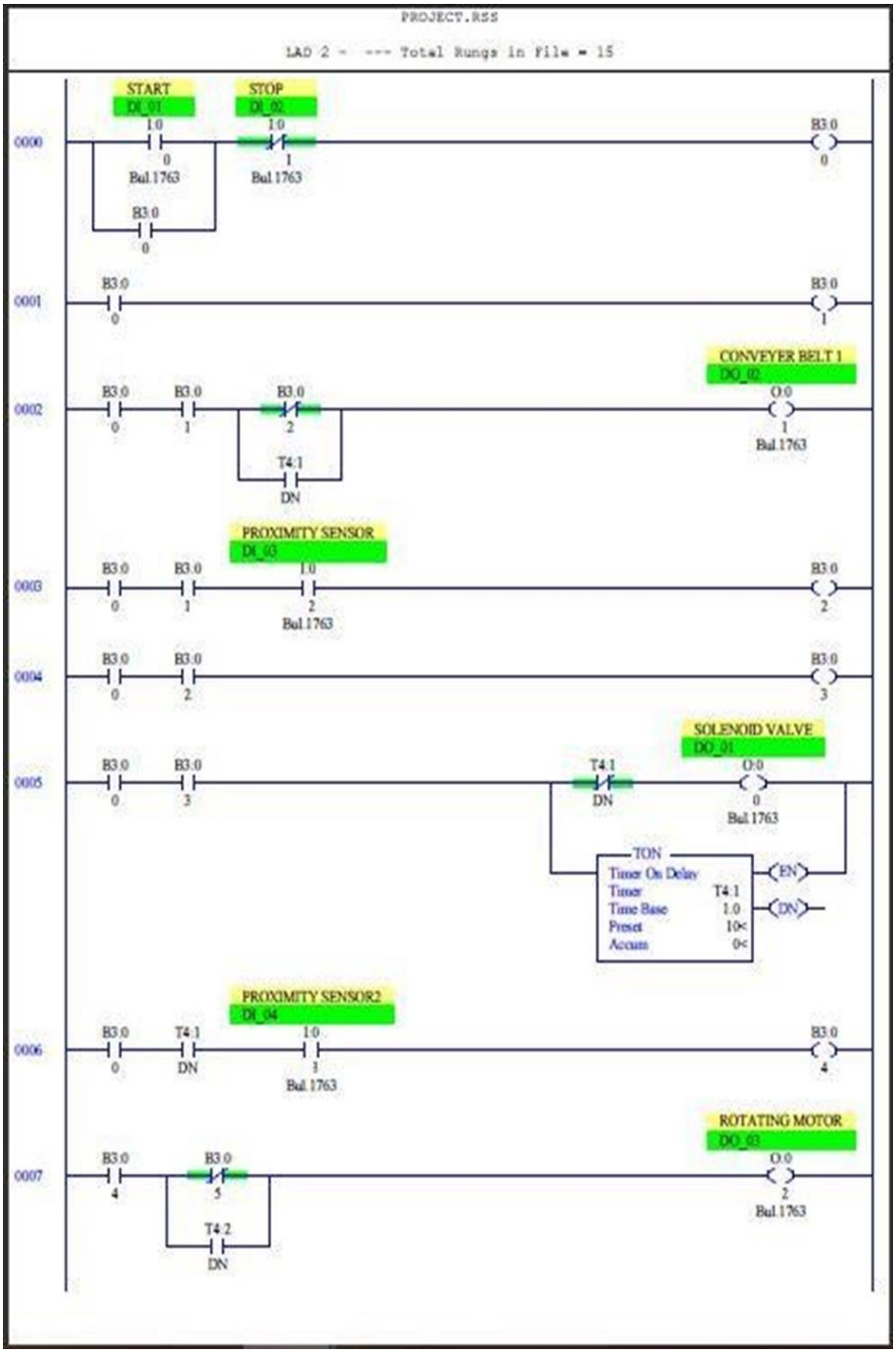


Figure 3: *The PLC ladder logic for filling assembly*

automatic bottle filling, capping and labelling using alarmmanagement system

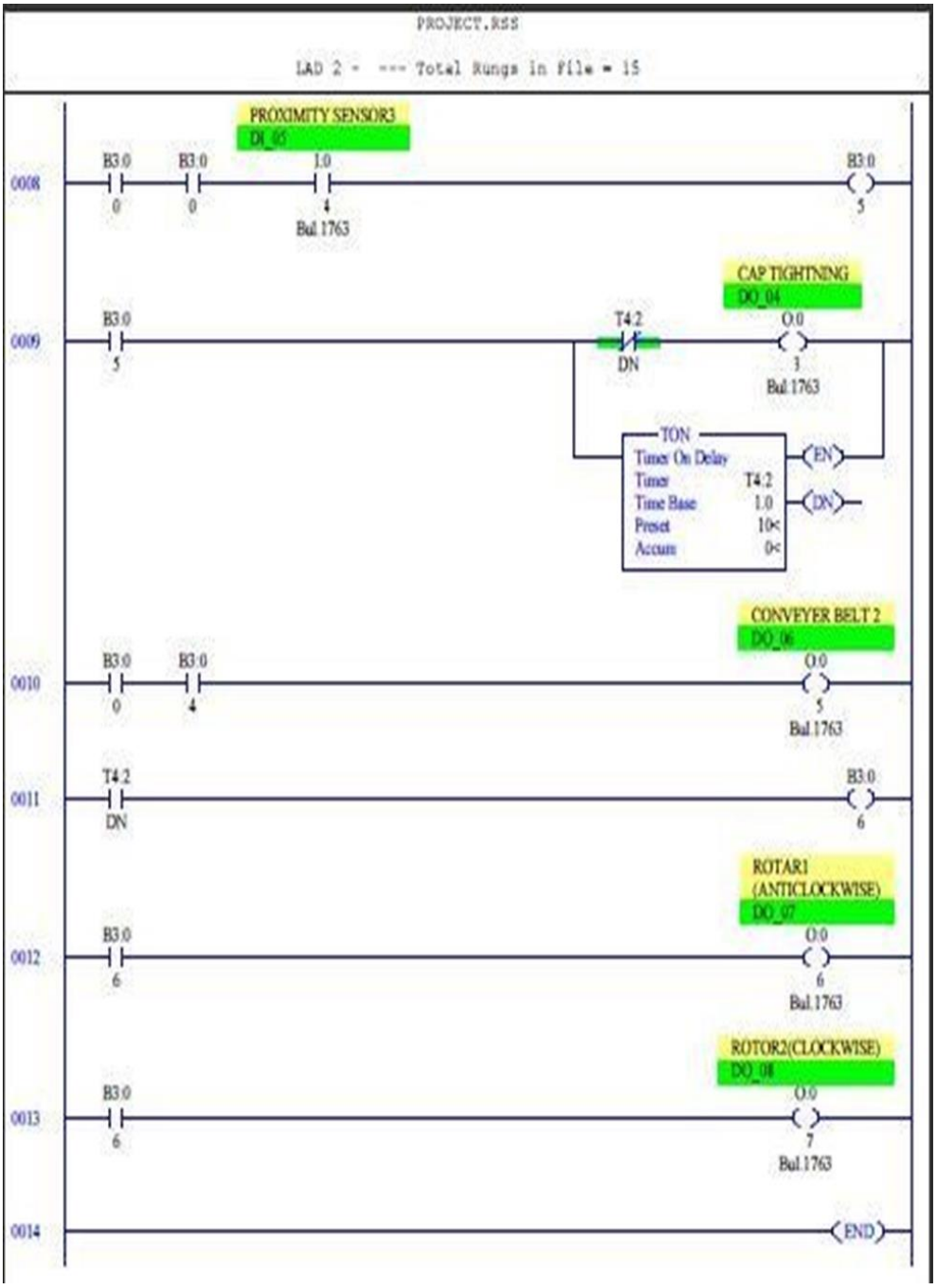
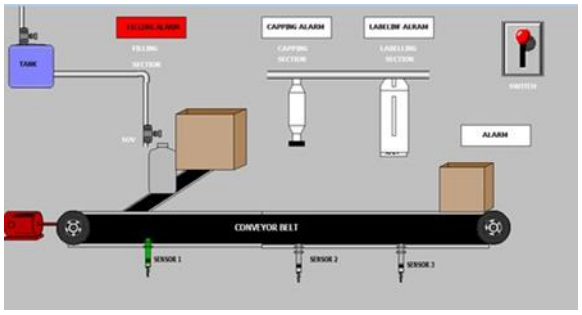


Figure 4: *The PLC ladder logic for capping and labelling assembly*

When the Operator will press the Start Pushbutton the process starts. The Conveyer belt 1 starts as soon as Start button is pressed. We assume that the bottle is placed on the conveyer belt and it moves forward on this conveyer belt. The conveyer belt will stop as soon as the proximity sensor 1 will detect the bottle. As soon as the conveyer belt stops the solenoid valve is opened to start the flow of water from tank to bottle. A fixed time delay is provided in which the bottle gets filled using the timer. As the timer is finished the conveyer belt is resumed. The bottle is then assumed to move forward on the belt. As the bottle reaches the 2nd proximity sensor the rotating motor starts which rotates the bottle to reach incorrect place for capping.

TESTING AND EVALUATION

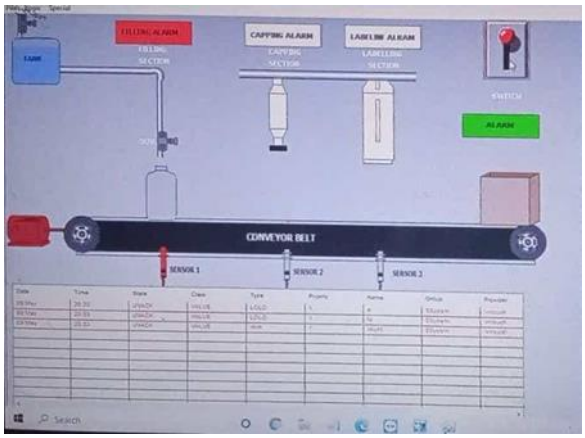
Filling



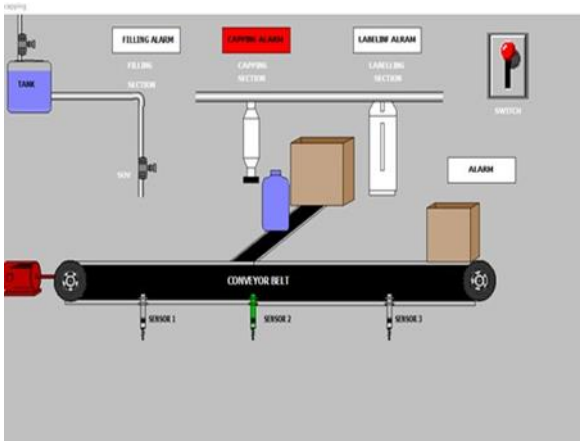
When the power supply button is pressed, the conveyor motor begins to run. The empty bottle is manually placed on the moving conveyor belt. As the bottle moves forward, a proximity sensor senses an empty bottle as it passes through the filling area, and the conveyor comes to a halt. The proximity sensor sends a signal to the solenoid valve, which opens the piston and syringe arrangement to fill the bottle. A 10- second timer is included in the filling scheme. The arrangement comes to an end after 10 seconds. After the filling process is completed,

When the 3rd proximity sensor detects the bottlethe rotating motor stops, also at the same time the cap tightening will start. It is stop after a fixed time depending upon the time delay provided on timer 2. When time 2 is done the conveyer belt 2(Labelling conveyer) is started where the labelling process will take place. Also, as per the logic when the cap tightening process is done 2 small conveyer belts which areplaced upside down on the labelling conveyer will start. The bottle passes through these 2 small belts where the label is placed on the bottle. This way the bottle continues to move ahead for dispatch. During the whole process if there is any uncertain emergency condition then the operator can press the Stop push button which will immediately stop the process. Also the process resumes by pressing the stop button again when the emergency condition is solved.

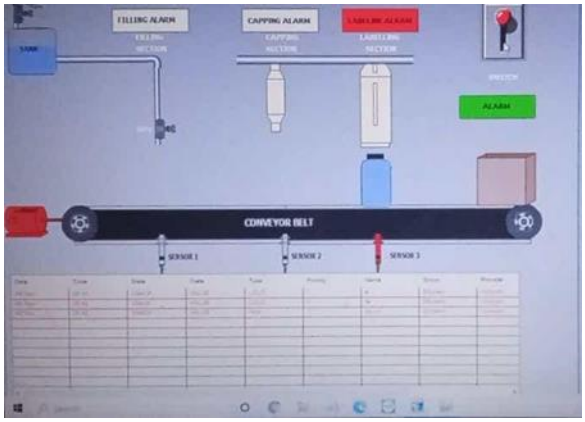
the dc pump shuts down. The bottle starts to move away from the dc pump when the conveyor motor shifts. This process will be repeated if another bottle is detected. If in any case the bottle is not filled or found damage or not detected then the bottle moves to another conveyor into the box and alarm get energize.



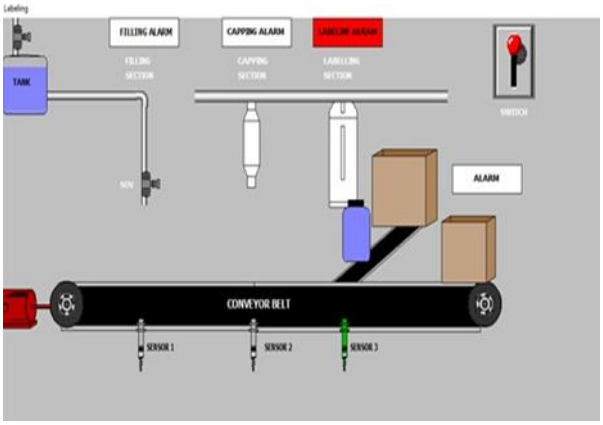
Capping



When the filling process is finished, the filled bottle is pushed to the capping mechanism, which is a motorized arrangement all in one unit. The bottle then reaches a circulating disk, where a proximity sensor detects a filled bottle and prevents the disc from rotating. After 5 seconds, the cap is placed on the bottle, and the disc begins to rotate again. The bottle then comes to a halt under the piston, which spines and tightens the cap on bottles. The assembly then moves the bottle to the next level, where it is pushed to the second conveyor belt for the labeling process. If in any case the bottle is not capped properly, then bottle moves to another conveyor and the alarm is energized.

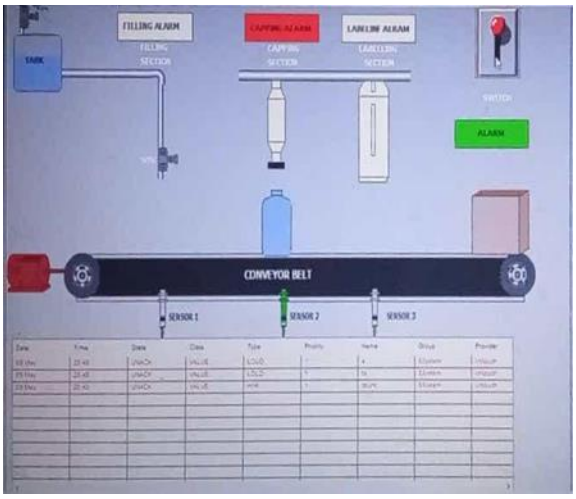


Labelling



The capped bottle is pushed to the labeling portion on the second conveyor belt as the capping

process is completed. As the bottle moves forward, a proximity sensor sends a signal or output, the two dc motors begin torotate, and one side of the sticker adheres to the bottle. As the bottle moves forward, the sticker adheres to the bottle. Following this, the assembly moves the bottle to the next level. If in any case the bottle is not properly labeled or not detected then bottle moves to another conveyor and then the alarm gets energize.



RESULTS AND DISCUSSIONS

Final Construction

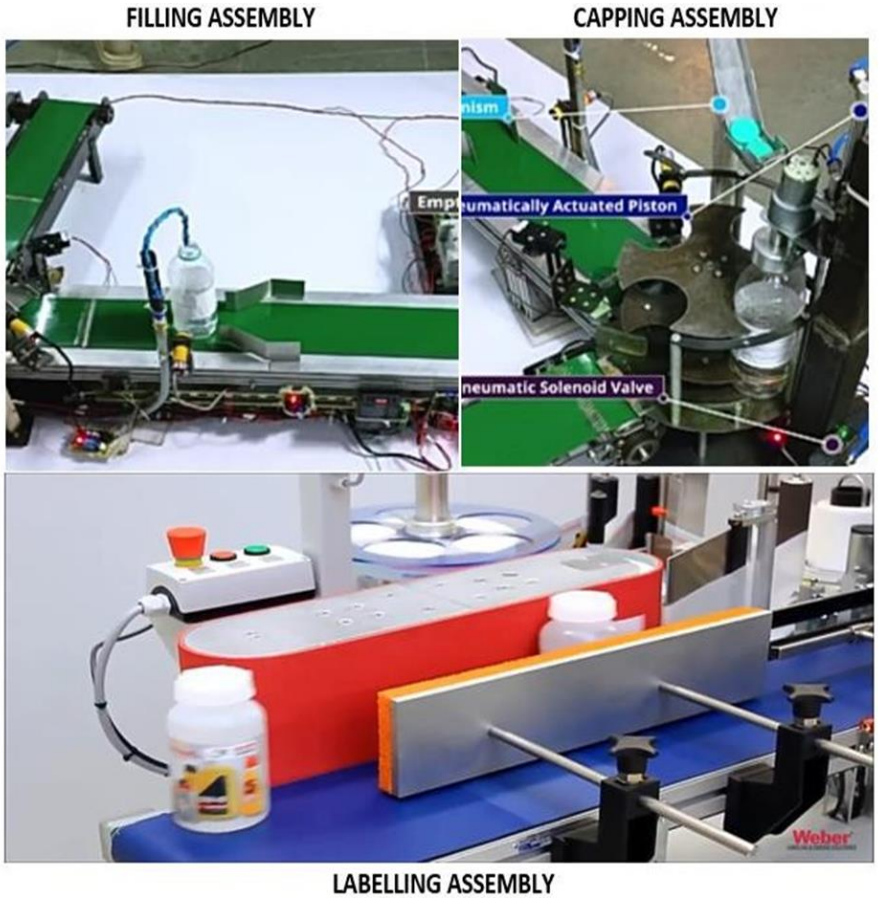


Figure 6: *Final Construction of an automatic bottle filling machine*

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 belt push the bottle towards capping station. will be repeated if another bottle is sensed. The capping head is responsible for spinning and tightening thecap 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 willtight the cap on bottle. As this process complete the disc 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 labeling conveyor motor will start and sticker will stick on bottle. After this step, the assembly pushes the bottle over to the next point where it is rolled down the system as a finished product

CONCLUSION

In this project, an automatic bottle filling machine is designed and constructed. All the components are performing well. It canfill 200 ml bottle. It is a time based controlsystem. It has some advantages over traditional filling process. This 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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