EXPERMINT: 08

- **Title** Container filling process using a programmable logic controller.
- **Aim:** To study and simulate Container filling process using a programmable logic controller.
- **Theory:**

Introduction

In order to understand, the container filling process, we need certain instrument like Motor, Conveyor, Solenoid valve, level sensor, proximity sensor, LED's, push button and Programmable Logic Controller.

Motor:

Motor is required to produce the torque and power required to pull the conveyor.

Level Sensor:

Level sensors are used to detect the level of substances that flow, which include liquids, slurries, granular materials etc. The substance which is being measured can be inside a container or can be in its natural form (e.g. a river or a lake). The measurement of level can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point.

The selection criteria include the physical phase (liquid, solid or slurry), temperature, pressure or vacuum, chemistry, dielectric constant of the medium, specific gravity of the medium etc.

Sensors which are available for point level detection of solids are:

- Vibrating point
- Rotating paddle
- Admittance type

Sensors which are available for point level detection of solids are:

- Pulse-Wave ultrasonic(Non Invasive):
- Magnetic and mechanical float
- Pneumatic
- Conductive

Sensor for both point level detection and continuous monitoring of solids and liquids:

- Ultrasonic
- Capacitance
- Optical interface
- Microwave

Sensors for continuous level measurement of liquids:

- Magnetostrictive
- Resistive chain
- Hydrostatic pressure
- Air bubbler
- Gamma rays

For our experiment Point level detection of liquids is concerned.

Proximity sensor:

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor always requires a metal target.

The maximum distance that this sensor can detect is defined "nominal range". Some sensors have adjustments of the nominal range or means to report a graduated detection distance.

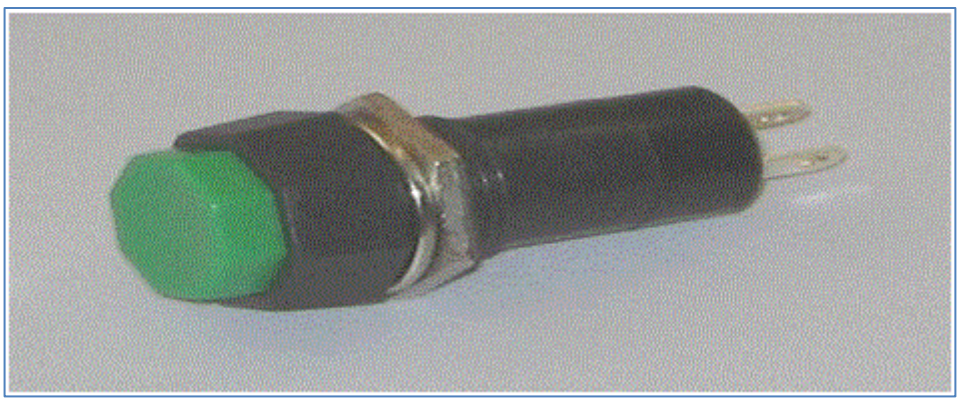
Proximity sensors can have a high reliability and long functional life because of the absence of mechanical parts and lack of physical contact between sensor and the sensed object.

Conveyor system:

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available, and are used according to the various needs of different industries.

Push button :

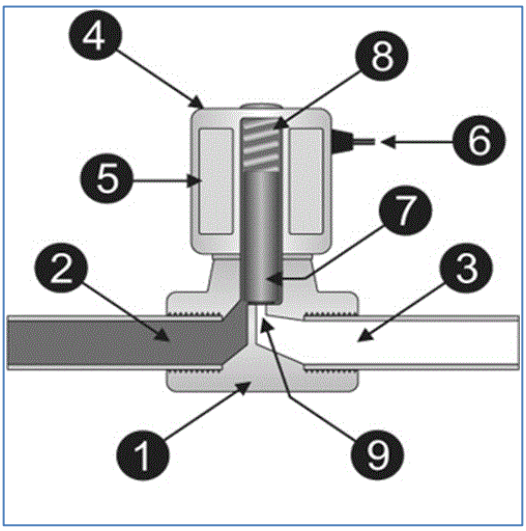
Push button is a kind of a switch which is activated or deactivated the moment we press or depress it. It sends a signal momentarily when we press or depress it.



Solenoid valve :

A solenoid valve is an electromechanical device used for controlling gas or liquid flow.

What are the different parts of solenoid?



In the above figure,

- Valve body
- Inlet port
- Output port
- Coil/solenoid
- Coil winding
- Lead wires
- Plunger
- Spring
- Orifice

The above figure shows the basic components of a solenoid valve. The above picture represents a normally-closed, direct-acting valve. This type of solenoid valve has the most simple and easy to understand principle of operation.

Let us see its working :

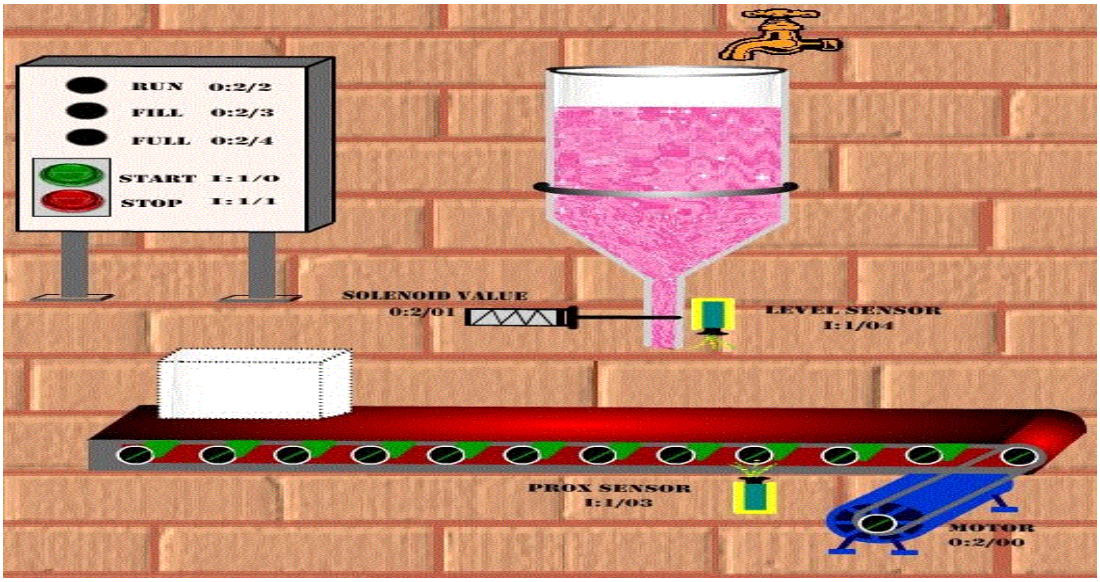
The media enters the solenoid valve through inlet port and must flow through the orifice before continuing into the outlet port. The orifice is closed and opened by the plunger.

The valve pictured above is normally-closed solenoid valve. Normally-closed valve use a spring which presses the plunger tip against the opening of the orifice. The sealing material at the tip of the plunger keeps the media from entering the orifice, until the plunger is lifted up by an electromagnetic field created by the coil.

Procedure :

Procedure : In our experiment, we wish to have a container filling process using a programmable logic controller.

Let us see its basic diagram:

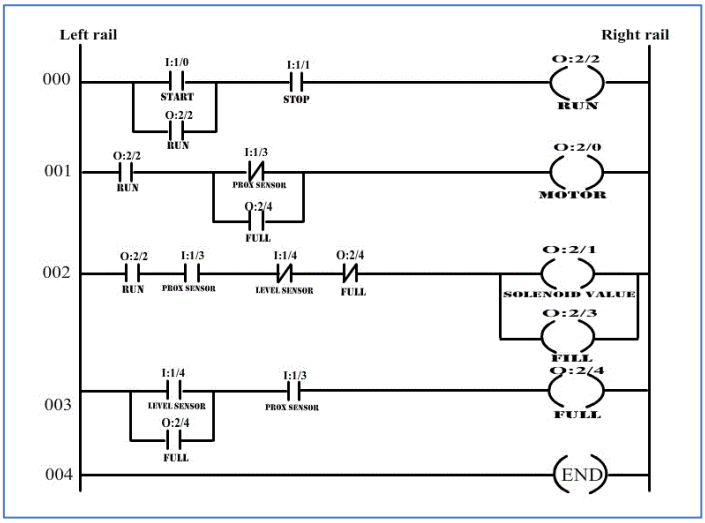


Since the inputs and outputs to the PLC are less, 8-point input module and 8-point output modules is sufficient, where CPU resides in slot 0, input module resides in slot and output module in slot 2.and output signal.

Let us assign address for the input and output signals of the PLC:

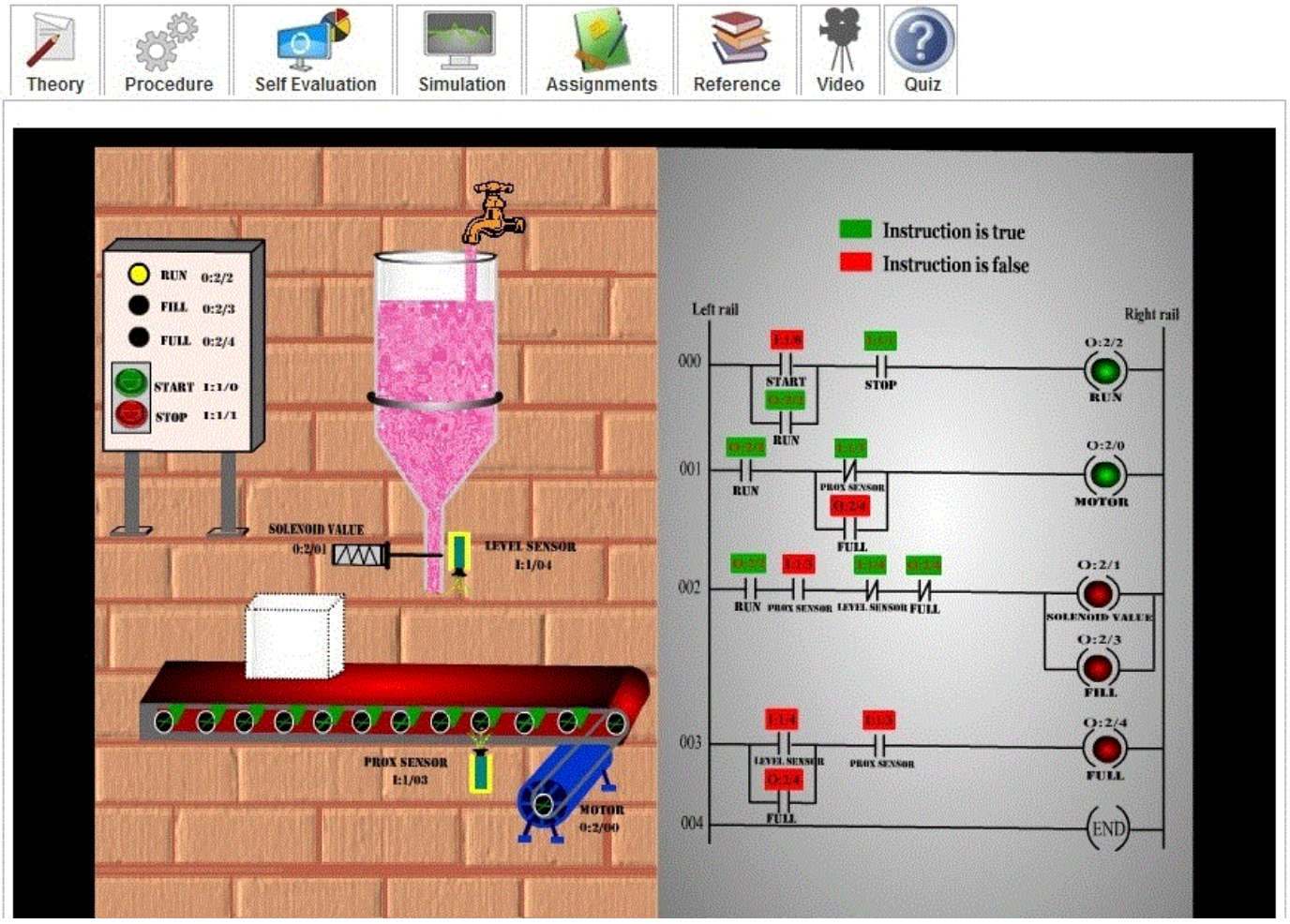
- Start (Normally open push button) : I:1/0
- Stop (Normally closed push button) :I:1/1
- MOTOR: O:2/0
- SOLENOID VALUE : O:2/1
- RUN (LED) : O:2/2
- FILL (LED) : O:2/3
- FULL (LED) : O:2/4
- PROX SENSOR(Proximity sensor) : I:1/3
- LEVEL SENSOR(Level sensor) : I:1/4

Let us see its ladder logic diagram:

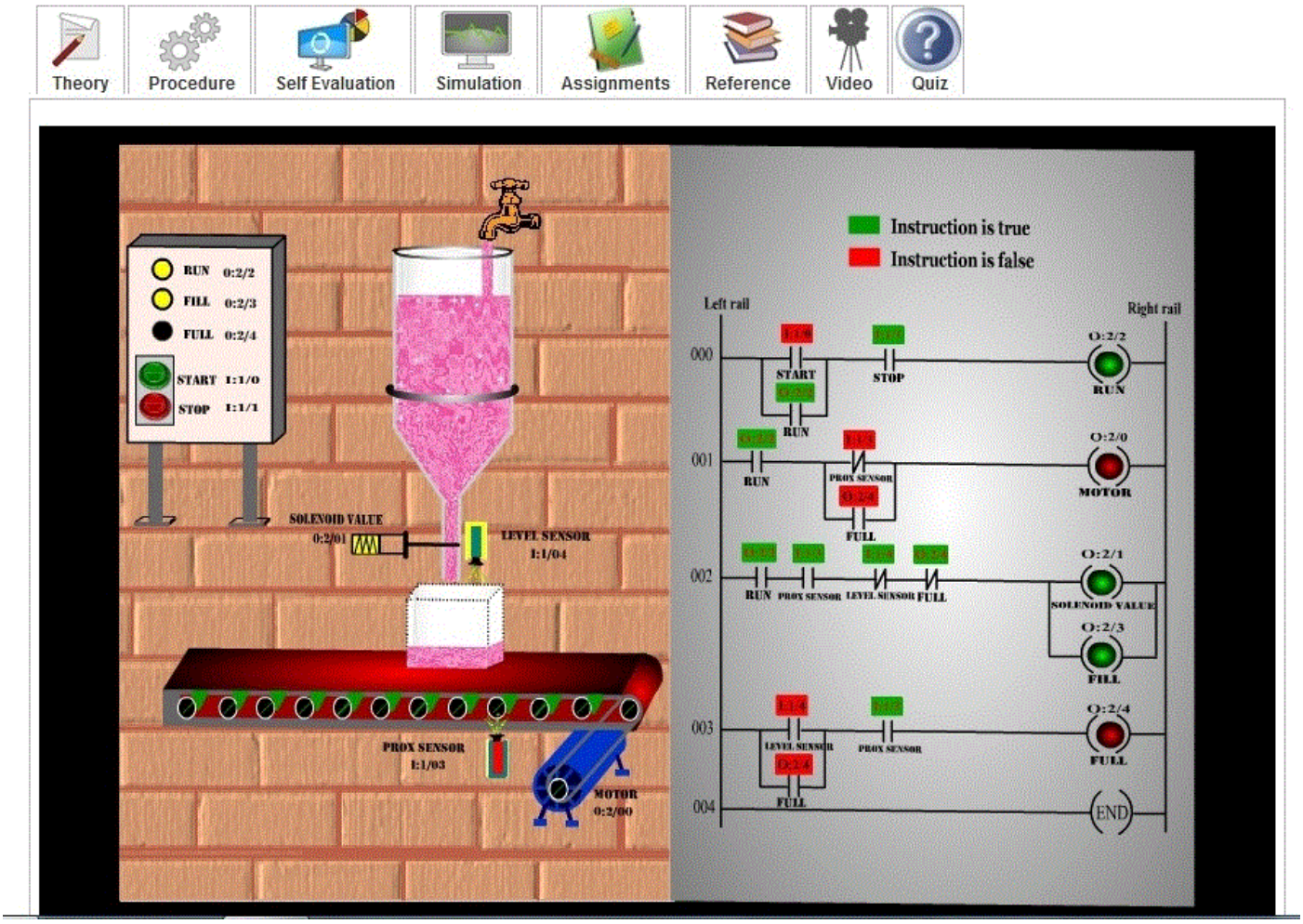


- Here, when the start push button is pressed, Container filling process gets started (motor is turned on) and RUN LED will glow. When the container reaches the filling position, proximity sensor (PROX SENSOR) senses its position and motor is stopped and solenoid valve will open. So the container starts filling till the container gets filled. During this time, FILL LED will glow. Once the container gets filled, completely, level sensor will sense the maximum limit and solenoid valve is closed. During this time, FULL LED will glow. Now, motor is started and container moves over the conveyor. This process is continuously executed.
- In order to understand the working of container filling process, click the start and stop push buttons and observe the ladder diagram and LED's correspondingly

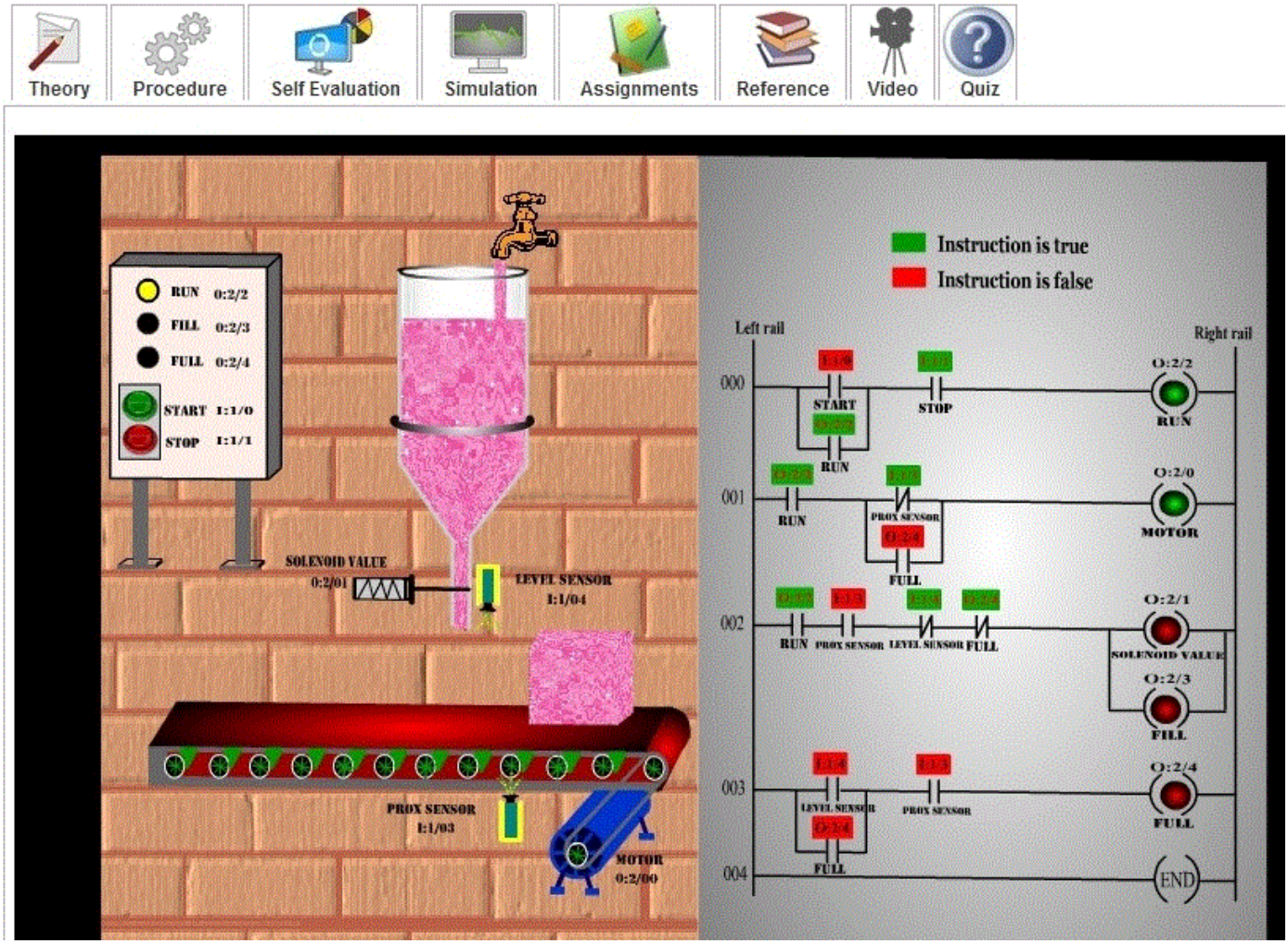
The following screen shot explains the operation:



The above screen shot shows the condition before the current-batch container gets filled.

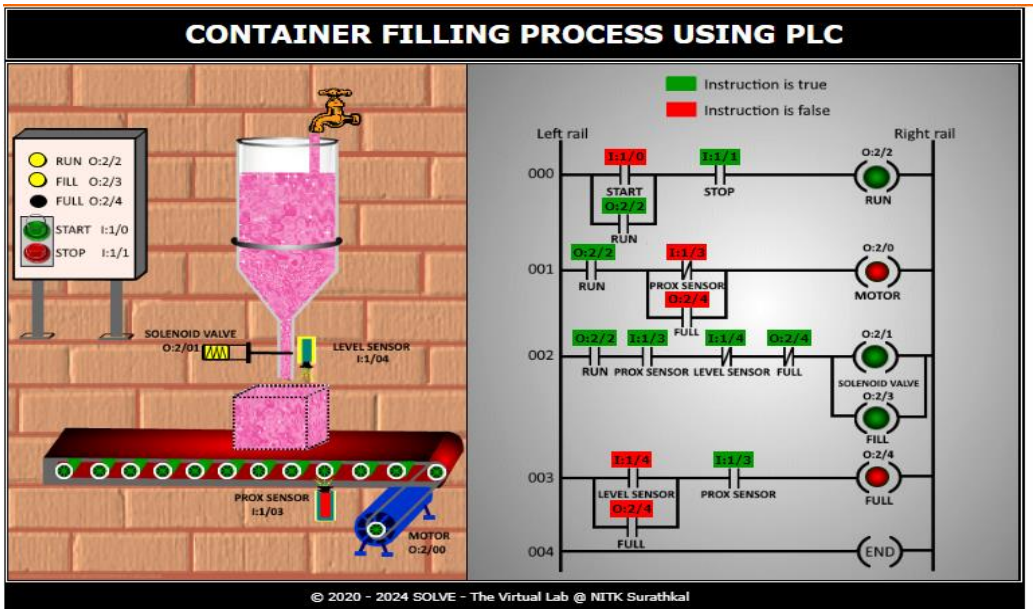


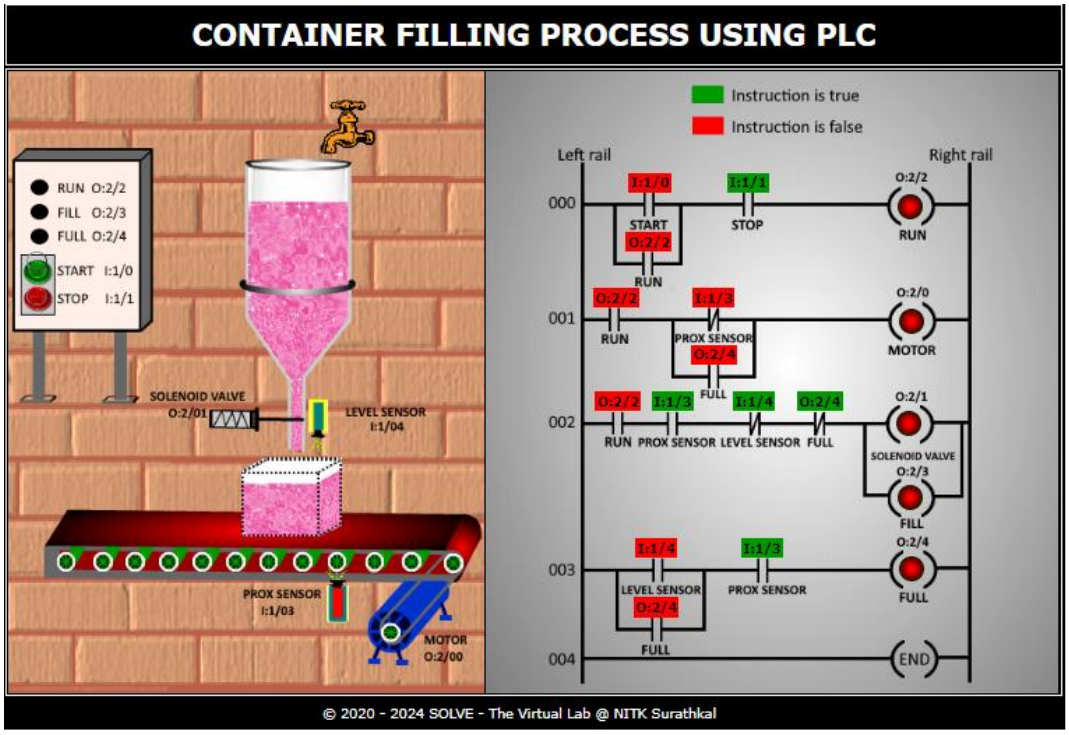
The above screen shot represents the condition when the current-batch container is getting filled.



The above screen shot shows the condition after the current-batch container gets filled and before the start of next batch.

Result:





Conclusion:

The study and simulation of container filling processes using a programmable logic controller (PLC) present a promising avenue for optimizing industrial manufacturing operations. Through the utilization of PLCs, which offer flexibility, precision, and automation capabilities, manufacturers can enhance efficiency, accuracy, and safety in container filling operations.