Simulation and Implementation of PLC based for Nonstop Filling Process using PLCSIM and HMI

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Abstract

This paper describes about to use the PLC techniques for automation of industrial product manufacturing to achieve high throughput and improved quality and consistency. In this system, PLC is used the heart of the system. The proposed system of operation is devised by ladder diagram Boxes which moving on a conveyor to be automatically positioned and filled with a continuous filling process. Software implementation is used for demonstrating the ease of operation with this control along with tuning of the entire system is offered. This paper presents a study by simulation and experimental models for proposed system of PLCs. Moreover, consideration was given to the design of an HMI for nonstop filling process with grains. The design stages included screen interfacing for the HMI, programming the HMI by assigning tags, integration into Step 7 brand of PLC using Ethernet, simulation of the program using the ladder diagram of the nonstop filling process with grains. Industrial automated systems, manufacturing industries is very useful HMI design.

Keyword: Human Machine Interface, Conveyor, Programmable Logic Controller (PLC), Level Switch, Proximity sensor

1.INTRODUCTION

This is one of the important application of PLC in the filling industry where the box, which are moving on the conveyor belt, to be automatically detected at the appropriate position and get it filled by any desired grains and also after getting filled the queued box gets chance to be filled. As PLC becomes requisite controller for these types of industry. A small demonstration of the process was performed with the help of PLC where a ladder diagram was created to control the process and the ladder diagram was run the PLC trainer kit to see its justification. Most industrial plants are automated without any interactions between machines and the operator [7]. Automation is making the processes automatic. It is the method of using control systems to operate and control the working of industrial processing technology. Nowadays, PLC is widely used in applications of digital world which is applied at the industrial sector. Normally, the PLCs have been used in the industrial field to control a mechanical movement, either of the machine or heavy machines for efficient production. The sequential operations and repeated operations in industries is normally carried out using PLC. In Food and beverage industries, is carried out by a machine as manual process. The validation of the results in a PLC based application is carried out using ladder diagrams which are logic based. PLC can be programmed using ladder logic, Boolean language and functional chart. Ladder logic makes use of symbolic set of instructions to create a controller program. Ladder logic reduces the complexity of programming and it's easy to design large modules in short span of time [3].

2.PROPOSED SYSTEM IMPLEMENTATION

2.1. Software Description

PLC programming has five categories. The following methods are as follows:
- Functional Block Diagram (FBD)
- Structure Text
- Instruction list
- Sequential Flow chart (SFC)
- Ladder diagram

Among of these five languages, ladder diagram is the most widely used language and is simple as compared to other languages in this system. Ladder diagram is mainly used in programmable logic controller (PLC).

2.2. System Implementation

As Start is a push button which generates a momentary command only, if Start command is pressed then the output System ON will be activated. The System ON signal Normally Open contact, Level Switch NC contact and Proximity NO contact is mainly used to control the solenoid valve. Proximity switch used because the filling has to be started when the box placed in correct position. By the time the box arrives under hooper, NO contact becomes NC), after all the logics are healthy then solenoid valve will be activated and starts filling. After filling box has moved out and filling again will start when next box comes under Hooper. Proximity switch NC contact is used and System ON signal NO contact is used here to control the Motor. Both proximity & Full signals are enabled then Motor will be started and conveyor will start running and box/package will start move. When the box is filled, the box moves to the other end and then motor starts at the same time.. It is used to control the solenoid valve operation. If solenoid activated then it starts filling the box and if solenoid valve de-activates then the filling will be stopped. Table 2.1 describes the relationship between the inputs and outputs to the following data.

Table 2.1 Relationship between the inputs and outputs

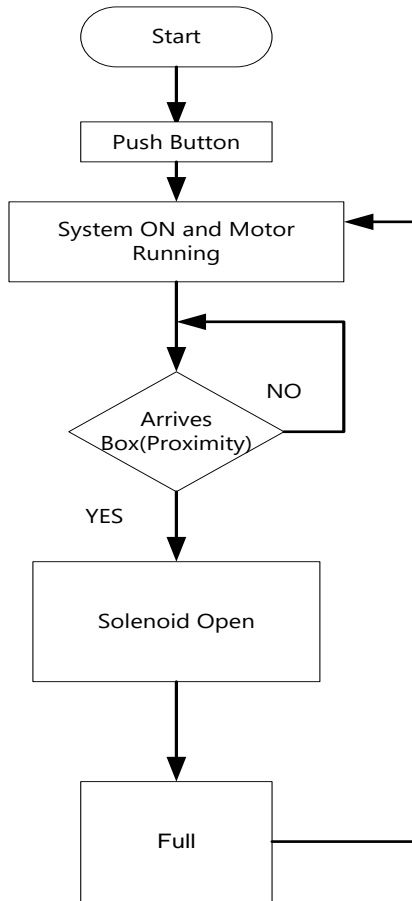| Inputs	Physical Elements
Start	Start Switch :Normally Closed
Stop	Start Switch :Normally Open
Proximity Switch	Proximity Switch :Normally Open Detect Position of box below the hooper
Level Switch	Level Switch: Normally Closed Detect filling level in the box
Outputs	**Physical Elements**
System ON	Status Signal
Solenoid	To control filling process from the hooper
Motor	To run the conveyor that the box move
Full	Status signal "Full"

2.3. Ladder Diagram
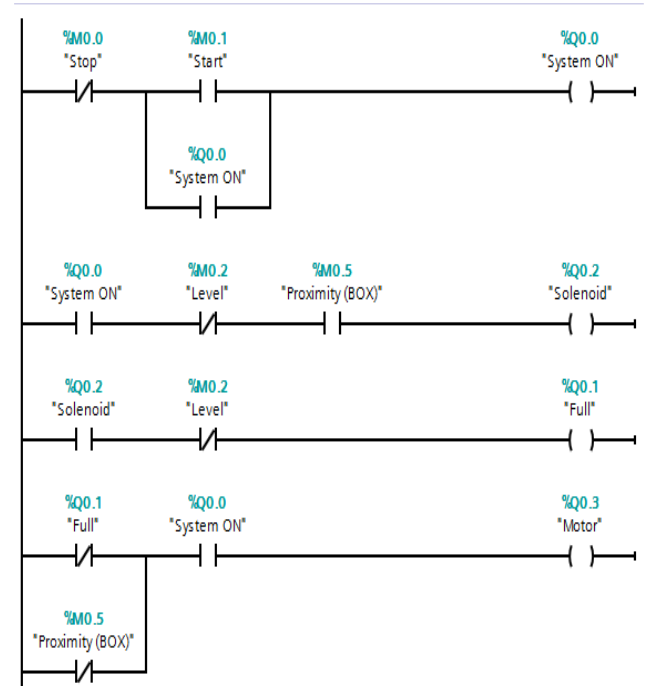
Figure 2.   PLC Ladder diagram of the proposed system

The ladder diagram of the proposed system was successfully checked in the PLC simulator and all the prescribed conditions were observed completely.

2.4. Overall flowchart of the System
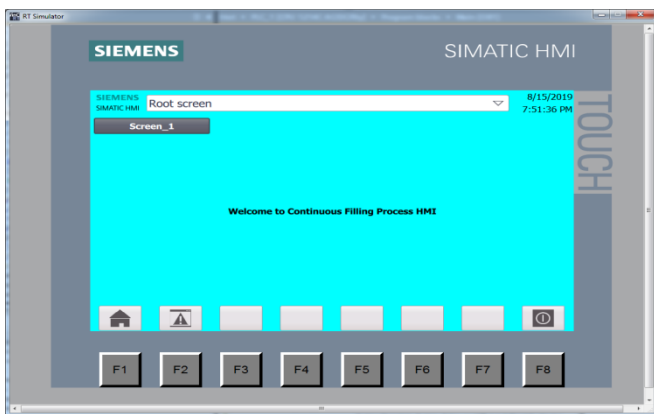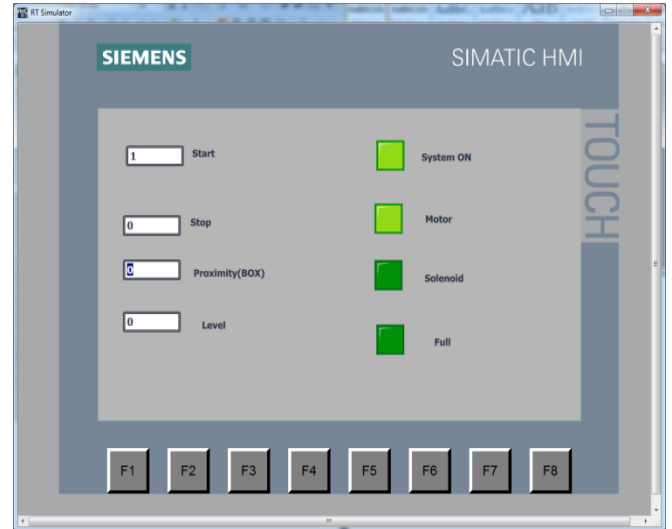
Figure 4. Status for System ON and Motor Running of PLC ladder Diagram

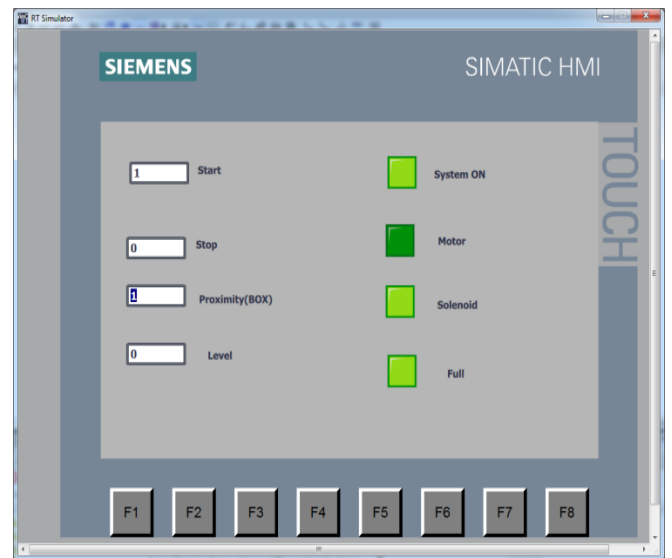The Start signal NO contact is pressed the system is ON and Motor will be operated.

Figure 4. Status the box arrives under hooper of PLC ladder diagram

That is why, solenoid valve will be activated when Start command is given (System ON signal NO contact becomes NC), level is Zero (Level switch NC contact used as default here), when box is placed under the hooper (proximity switch NO contact) is used. By the time the box arrives under hooper, NO contact becomes NC) ,

3.TEST and RESULTS

Simulation between HMI and PLC Program is used to test the response using TIA portal software.
Figure 3 depicts the system screens using the HMI device wizard is configured.

Figure 3. View of HMI Screen

Start → Push Button → System ON and Motor Running → Arrives Box(Proximity) → NO / YES → Solenoid Open → Full

after all the logics are healthy then solenoid valve will be activated and starts filling.
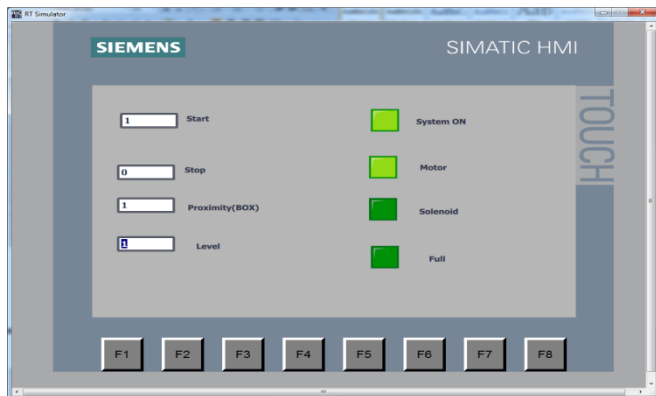

Figure 5. Output status for system of PLC ladder diagram

Figure 5 describes After that level reaches 100% then level switch will become NO and thus stopping the filling by de-activating the solenoid valve.

4.CONCLUSIONS

The design of HMI has been achieved using Siemens Simatic WinCC Flexible Advanced software. The additional feature in the system is the use of HMI for monitoring the complete system and the process may be started and stopped through HMI screen that effectively avoiding unnecessary wastage of grains. The programming for this system is flexible and easy. The system useful in industries like such as beverage, mineral water and food industries. Simulation results validated the correctness and applicability of the generated HMI program. Manufacturing industries can easily adapt to the implementation of HMI as part of their industrial automation systems to make process visualization of the plant easier, locate faults rapidly such as dangerous environments.

5.ACKNOWLEDGEMENT

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