

Simulation and Implementation of PLC Based for Detecting Burned Potato Chips and Remove using PLCSIM and HMI

Htet Htet Aung¹, Thu Zar Thein²

¹Lecturer, ²Associated Professor

^{1,2}Department of Electronic Engineering, Technological University, Taunggyi, Shan, Myanmar

How to cite this paper: Htet Htet Aung | Thu Zar Thein "Simulation and Implementation of PLC Based for Detecting Burned Potato Chips and Remove using PLCSIM and HMI" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-5, August 2019, pp.1644-1649, <https://doi.org/10.31142/ijtsrd26724>



IJTSRD26724

pp.1644-1649,

Copyright © 2019 by author(s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



Automation can be found in industries like steel factories, food and beverage industries scientific automation and so on. One of the control systems is Programmable Logic Controller, PLC, or programmable controller, using digital computer for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, or light fixtures [3].

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].

II. BACKGROUND THEORY

A. PLC (Programmable Logic Controller) System

A Programmable Logic Controller (PLC) is a specialized computer used for the control and operation of

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. Light dependent sensor, push button switch, light source, conveyor and blower is controlled by PLC. The proposed system of operation is devised by ladder diagram. 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. In this paper, consideration was given to the design of an HMI for an automated burn chips removed from conveyor which can be operated automatically by the press of start buttons. 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 "PLCSIM" and the programming codes of the automated burn chips. The designed HMI will be useful to manufacturing industries having industrial automated systems.

KEYWORDS: Human Machine Interface, Conveyor, Programmable Logic Controller (PLC), Sensor, Timer, Blower

I. INTRODUCTION

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.

manufacturing process and machinery. In the automobile industry to provide flexible, ruggedized and easily programmable controllers to replace hard-wired relays, timers and sequencers were first developed. The functionality of the PLC has evolved over the years to include sequential relay control, motion control, process control, distributed control systems, and networking. The data handling, storage processing power, and communication capabilities of some modern PLCs are approximately equivalent to desktop computers. PLC was developed as a replacement for large amounts of relays. The functional block diagram of the Programmable logic controller is shown in Figure 1.

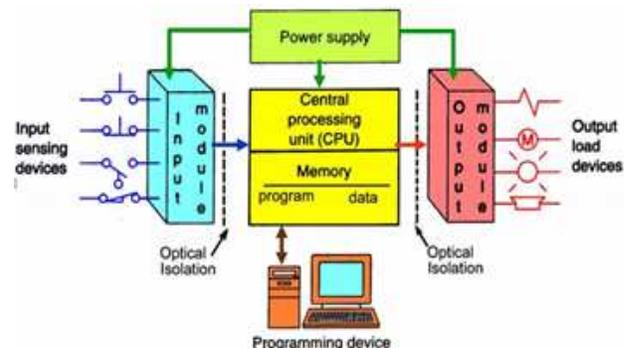


Figure1. Block Diagram of Programmable Logic Controller

The Figure 1 represents the basic block diagram of the Programmable Logic Controller, which consists of the input module, central processing unit (CPU), and the output module. The three modules have been explained in detail as follows. The input/output system is the part of the PLC that physically connects to devices in the outside world. The central processing unit, on the other hand, is where the PLC stores all of its data and does all of its computer processing. Each of the components of a PLC has specific functions. The input/output system is made up of two components, the input interface and the output interface. An input interface is a bank of terminals that physically connects input devices, like push buttons and limit switches, to a PLC. These input devices provide data to the PLC. The role of an input interface is to translate data from the inputs into a form that the PLC's central processing unit can understand. An output interface is a bank of terminals that physically connects output devices, such as solenoids and motor starters, to a PLC. These output devices receive control data from a PLC. The role of an output interface is to translate data from the PLC's CPU into a form that the output devices can understand. To put it simply, the I/O system communicates information from the input devices to the CPU. It also communicates data from the CPU to the output devices [6].

B. (HUMAN MACHINE INTERFACE)

A Human Machine Interface (HMI) is a device for providing the means of controlling, monitoring, managing and visualizing device processes. With controls and readouts graphically displayed on the screen, the operator can use either external buttons or the touch screen to control the machinery [7]. HMI can also be defined as the interaction between a PLC system and an operator. The interaction is presented by a screen with dynamic icons, figures and text. An operator can monitor the production and control it to a certain level by the help of an HMI panel or PC [9]. As technology systems grow more complex, issues of end-product equipment safety, ease of operation and reducing the risk of human error are becoming extremely important. Designers today know that the operational performance, efficiency and safety of a wide range of systems are closely related to the interaction between humans and machines in other words the HMI. The selection and seamless integration of HMI components such as switch controls, actuators and indicators, are critical to the success of equipment designed for human operation. The goal of interaction between a human and a machine at the user interface is effective operation and control of the machine and feedback from the machine which aids the operator in making operational decisions. The user interface includes hardware and software components. User interfaces exist for various systems and provide a means of input allowing the users to manipulate a system, and output allowing the system to indicate the effects of the users' manipulation. The most important features of having HMI are high quality graphics for realistic representations of machinery and processes, alarms, trends, simulation, messaging, animation of equipment based on operator standards, hardware cost reduction and communication Simatic WinCC Flexible Advanced software is ideal for use as the HMI software in all applications in which operator control and monitoring is required on site whether in production or process automation. WinCC Flexible Advance is Windows-based engineering software created by Siemens for producing HMI screens. The screens are available for use on Simatic HMI

operator control and monitoring devices as well as standard PCs. In terms of design criteria, the HMI should have the following features:

- Communicate with Siemens Simatic Step 7 brand of PLC;
- Give a very realistic view of industrial plant;
- Reduce hardware by replacing many push buttons, selector switches and lights;
- Replace humans in tasks done in dangerous environments; and
- Allow the operator to start and stop cycles

III. PROPOSED SYSTEM IMPLEMENTATION

A. Software Description

There are five important languages which are used for the programming of the PLC. The lists of the 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 logic is the main programming method used in PLC.

B. Software Implementation

Step 1: Create the project with the TIA Portal software

Open the TIA Portal software. The user will see the portal view of the TIA Portal v13. In this view, the user will create the new project with the desired name. At this step, user can change the project view from the portal view.

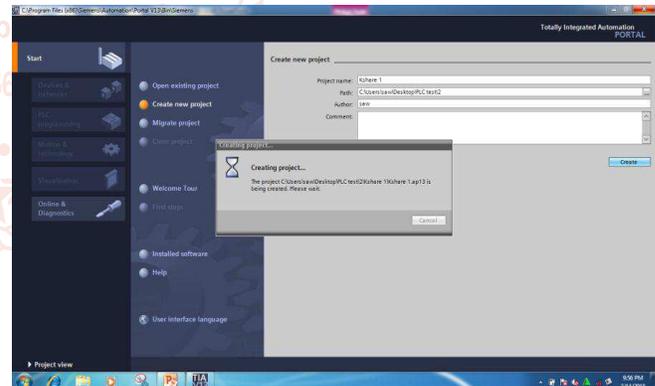


Figure2. Creating a new project with the TIA Portal v13

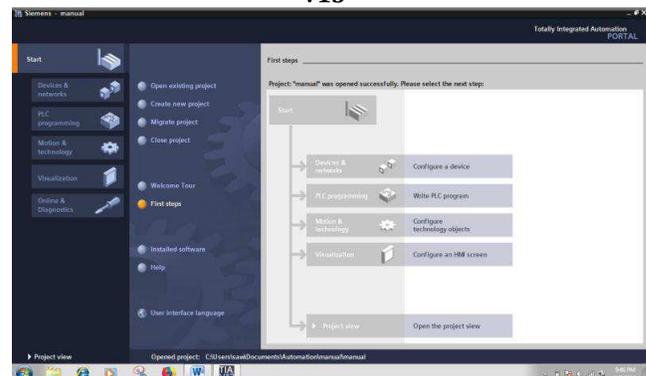


Figure3. Showing the portal view after creating the new project

C. Interfacing with Human Machine Interface (HMI)

Step 1: Firstly, the first step is configuring the hardware configuration of the project, where the user can create HMI connection with your control system or other devices. In this step, the user will define the CPU in that the program will be downloaded. Firstly the user should use 'Add new devices' common. At that time 'add new device' box is appeared. In this box, the user can select either controller or HMI. Only the controller will be used in this experiment. The user must select the CPU with the serial number as shown in figure 5 above. Similarly, the user is done this the above ways. Now by clicking on header of HMI project tree and next KT700 Basic Panel is chosen. Moreover, the user can choose 7 display and then the later are chosen in figure 10(a),(b),(c) (d) and(e).

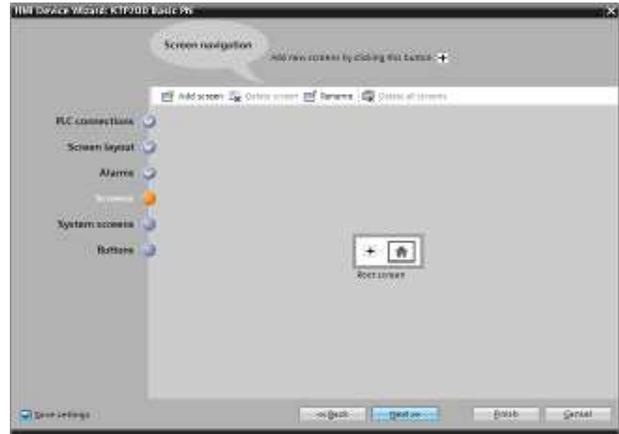


Figure10 (d).Configure the screen navigation using the HMI device wizard



Figure10 (a). Ethernet Connection between the HMI and the PLC



Figure10 (e). Configure the system screens using the HMI device wizard

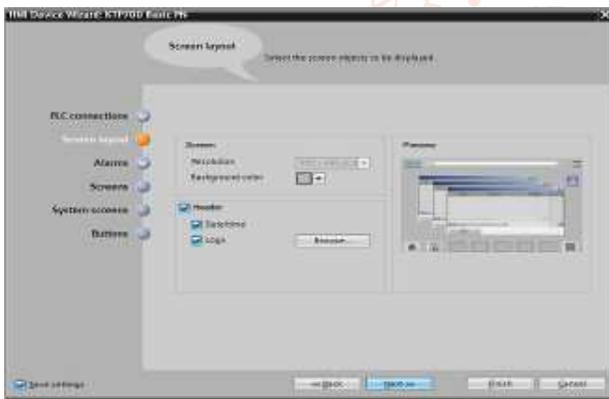


Figure 10 (b). Creating the screen layout using the HMI device wizard



Figure10 (c).Configure the alarms setting using the HMI device wizard

Next - Next -Next - Finish. Options “screens” serve for the defining screen panel can be modified. Screen by editing by double click on name of screen which the user change or edit is shown in figure 11.

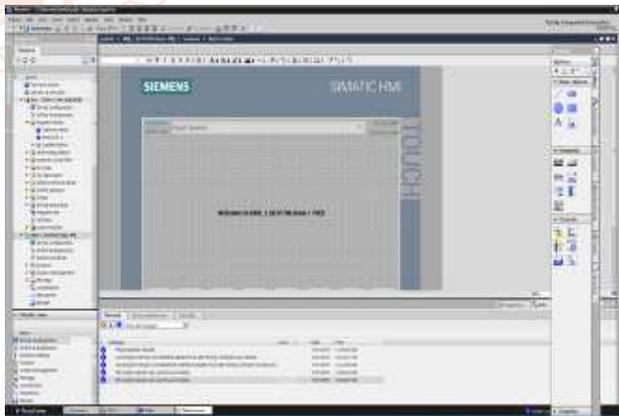


Figure11. Simatic HMI window

Finally, if user is used the input tags as push button and the output as pilot lights. Right Click- properties- general tag will see the view of HMI tags shown in figure 12(a), (b).

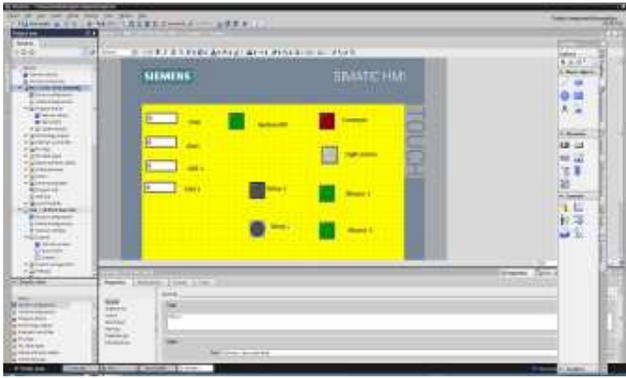


Figure12 (a) Control Elements on the Main Screen



Figure13 (b). Downloading the ladder program to the virtual PLC in the PLCSIM (After connection)

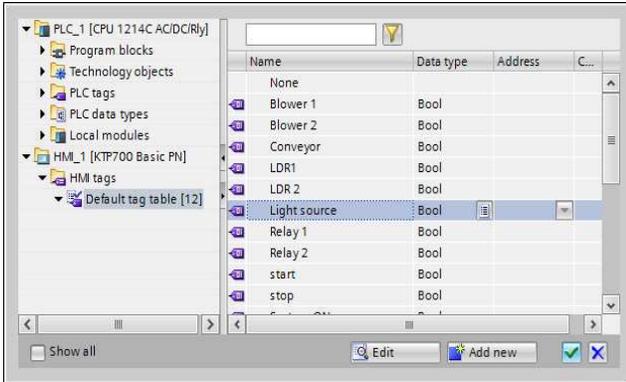


Figure12 (b). Created Tags of the burned potato chips

Step 1: Both PLC and HMI devices are compiled and start simulation of the system.

Step 2: Test the program by using TIA Portal software. At this step, the user can test how to do the program either in the software at the same time.

Step 3: The user should do all the steps of the experiment before using the PLCSIM.

Step 4: To download the ladder program to the virtual PLC instead of the CPU, the user can use the PLCSIM software. So, firstly the user can open the PLCSIM software. Finally the user can download the ladder program to the virtual PLC that is created with the PLCSIM software using the download common in the TIA portal software.

D. LADDER DIAGRAM

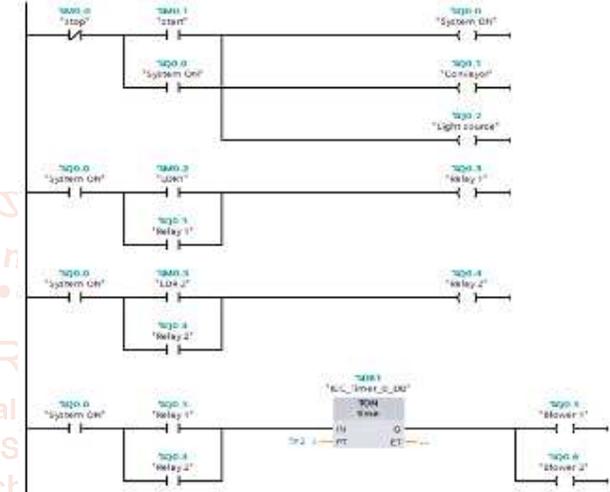


Figure14. PLC Ladder diagram of the proposed system

After the user will completely successful of experiment, the process will be seen.

IV. TEST AND RESULTS

Simulation between HMI and PLC Program is used to test the response using TIA portal software. Figure 15 depicts the status of ladder diagram, latching circuit is used for cycle ON. Addition, START push button is used to start the system. When the system is ON, Conveyor and light source will be ON.

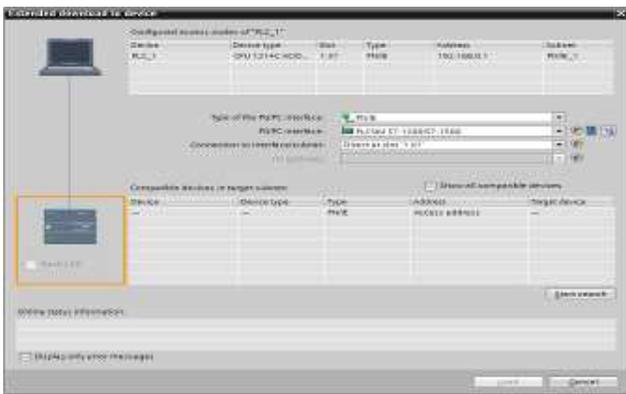


Figure13 (a). Downloading the ladder program to the virtual PLC in the PLCSIM (before connection)



Figure15. Status for system ON, conveyor and light source ON



Figure 16. Status for LDR1 and relay 1 of PLC ladder diagram

Figure 16 presents the system is ON and LDR 1 will be detected. That's why Relay 1 will be ON.

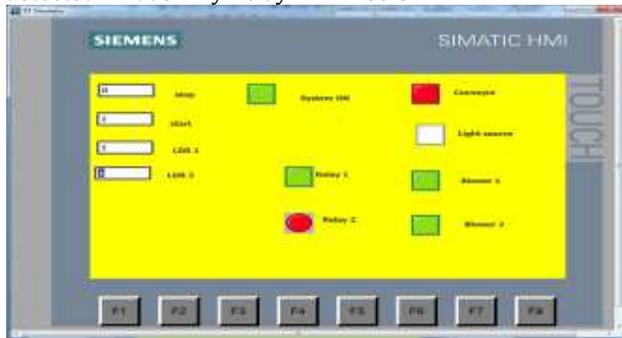


Figure 17. Status for LDR2 and relay 2 of PLC ladder diagram

When the system is ON, LDR 2 sensor is detected burned chips on the conveyor and then Relay 2 will be operated. The pushbutton STOP PB to stop the cycle is used.



Figure 18. Output status for timer operation of PLC ladder diagram

Figure 18 describes either relay 1 or relay 2 is operated, timer instruction will be executed. During this system is ON, timer output is ON, blower 1 will be ON. Similarly, timer output is ON, blower 2 will be ON. When LDR sensors detect burned chips on the conveyor, blower's timer (2s) will be ON and it will throw away the burned chips from the conveyor. Assuming 2s travelling time taken by chips to reach from light source to blowers.

V. CONCLUSIONS

The design of HMI has been achieved using Siemens Simatic WinCC Flexible Advanced software. Simulation of the

program using "Simatic PLCSIM" was conducted to check the functionality of the PLC program created. 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 and to help replace humans in tasks done in dangerous environments.

VI. ACKNOWLEDGEMENT

The authors want to extend heartfelt thanks to Dr. Aye Aye Nwe, Professor, Department of Electronic Engineering, Technological University (Taunggyi) who provided me with not only guidance and advice on my research but also encouragement and helpful suggestions throughout the research. Special thanks to Daw Thu Zar Thein, Associate Professor, Department of Electronic Engineering, Technological University (Taunggyi), for her patience continuous suggestions throughout the research.

REFERENCES

- [1] P. Thirumurugan, "Automatic Sorting in process Industries using plc," *Global Research and Development Journal for Engineering*, ISSN: 2455-5703,,Volume 3 | Issue 3 | February 2018
- [2] SBharadwaj Reddy (2018,August 19) <http://www.instrumentation tools.com>
- [3] Tanmay Sharma¹, Dhruvi Dave² and Hinal Shah³, "Implementation of Automatic Color Mixing and Filling Using PLC & SCADA", ISSN 2278-6856 Volume 6, Issue 3, May- June 2017
- [4] Kiing Ing Wong and Teck Ung Siaw, "PLC and SCADA Laboratory Experiments for a Final Year Instrumentation Course," *International Journal of Information and Education Technology*, Vol. 5, No. 11, November 2015
- [5] Krupal R Bhoi , Priyank R Patel, Dhaval S Sukhanandi, Avadhesh Yadav, "PLC BASED ELEVATOR CONTROL SYSTEM" Gujarat Technological University, Ahmedabad, May, 2015
- [6] N.Keerthipriya¹, R.S.Lalithaa², S. Ramapriya³, S. Sivaprakasam, "PLC Based Industrial Conveyor Automation and Monitoring," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, ISSN: 2321-9653, Volume 3 Issue III, March 2015
- [7] Erwin Normanyo, 2 Francis Husinu, 3 Ofosu Robert Agyare, , " Developing a Human Machine Interface (HMI) for Industrial Automated Systems using Siemens Simatic Win CC Flexible Advanced Software," ISSN 2079-8407, Vol. 5, No. 2 February 2014
- [8] W. Bolton, "Programmable Logic Controllers," in, 4th edition. Published by Elsevier Newnes,2006
- [9] Siemens AG Automation and drives, "operating manual for win CC flexible 2008 Compact/standard/advanced,"