Building surveillance control system for multiple PLC SIEMENS S7-1200 with standard of Ethernet communication

Quoc Hung Duong, Quynh Nga Duong

Abstract— **The explosion of "*Industrial Revolution 4.0*" is happenning intensely. The problem of controlling devices in the factory is not only a "point to point" but also connected to the network, communicates data with each other, and it also has the ability to synchronize data onto the Internet in the simplest way but still has high security. SIMATIC S7 1200 is a new solution of Siemens, equipped with standard of Ethernet communication and a powerful software toolkit, which has been solving complex industrial problems. This paper presents This paper presents the building of Wincc-based monitoring control system to communicate with multiple S7 1200 PLC stations using Ethernet communication standard. The real results are used to research and develope data synchronization and control machine on the Internet, contribute to the development of IoT-based technology (Internet of Thing).**

Index Terms **— PLC S7-1200; PLC network; Industrial Ethernet; Tia Portal.**

I. INTRODUCTION

In a large factory, there are usually many workshops with different PLC stations, each of which performs a separate job, they are networked together and can send interconnected signals [1] [2]. These stations are usually controlled and monitored by a host computer in the central control room via a SCADA (or DCS) software. Communication control for PLCs can be done via Profibus, CAN, MOSBUS, Ethernet networks ... The design of an Ethernet network will be highly economical, allowing the transmission of information and the number of connection points. bigger than other media networks. The experimental results of the article have proved the simple but effective utility of this communication network.

II. OVERVIEW OF ETHERNET STANDARD

Industrial Ethernet is a management and factory workshop network that facilitates communication between computers and automation systems. It helps to exchange amounts of large information and communicate over a wide range.

Nowadays, Ethernet is a common communication technology in processing electronic data systems. In offices and industrial factories, Ethernet is built and completed as a standard technology and provides a wide range of tool and information transmission equipment such as : copper cable, optical cable, wireless technology (wire-less), with transmission speed range from 10 Mbit/s and 100M bit/s to 1G bit/s and 10Gbit/s.

Figure 2 shows an example of hierarchy of automation

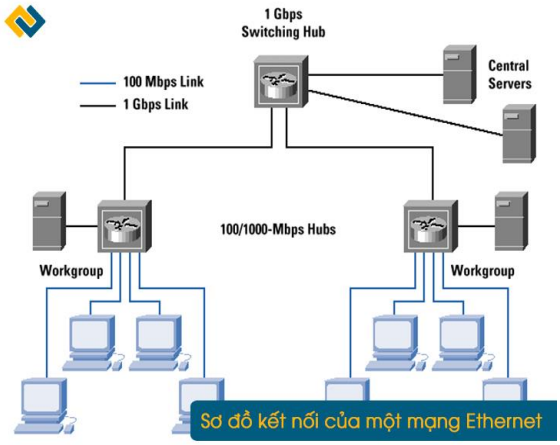

Figure 1. Connection diagram of an Ethernet network

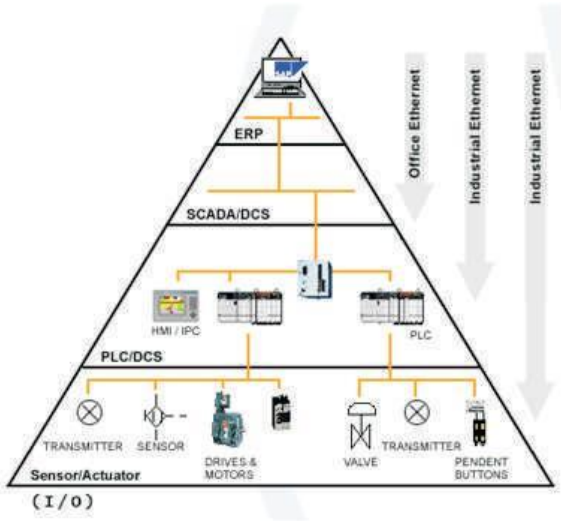

Figure 2. Decentralization of automation systems in industry

system in industry, inside:

- ERP: Enterprise resource planning
- SCADA: Supervisory control & data acquisition
- DCS: Distributed control system
- PLC: Programmable Logic Controler
- Fieldbus

Fieldbus available on the market today is using many different types of data transport and display of higher level

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networks through gateway. Most fieldbus manufacturers have developed their protocols based on Ethernet standards such as: Modbus/TCP; EtherNet/IP; ProfiNet, FF HSE; PowerLink

III. Overview of PLC Siemens S7-1200

PLC S7 - 1200 is a new series of SIEMENS. it is simple automation equipment but with high accuracy.

PLC Siemens S7 - 1200 is designed to be flexible compact modules, and suitable for applications.

Figure 3. PLC S7-1200 kit and modules extend

PLC Siemens S7 - 1200 has communication display that satisfies the highest standard of industrial communication and is full of built-in powerful technology features . It becomes a completed and all-sided automation solution.

With a modular and high function design, SIMATIC S7-1200 is suitable for many automation applications, from small to medium levels. The outstanding feature of PLC S7-1200 is built-in communication Profinet port (Ethernet), used the same TIA Portal software for PLC programming, HMI monitors and surveillance control display SCADA - Wincc. This helps the design, programming, construction of control systems quickly and simply.

PROFINET communication with: Programming devices; HMI equipment; Other SIMATIC controllers.

Supports connection protocols: TCP / IP; ISO-on-TCP; Communicate with S7; Profibus connection and PTP connection (point to point connection).

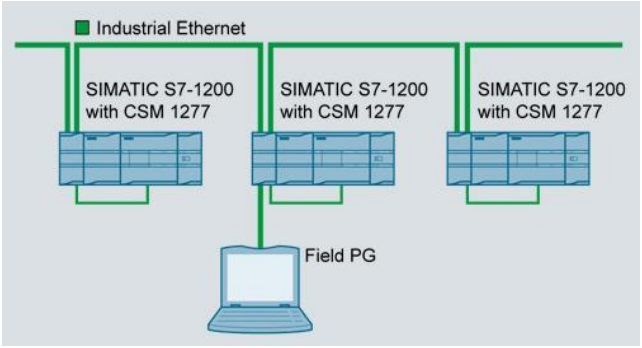

Figure 4. Industrial Ethernet network using PLC S7-1200

IV. Building a model of surveillance control system for three PLC S7 1200 stations via Ethernet standard

The model for testing is built with three S7-1200 stations.

+ Station 1: PLC S7-1200 CPU 1212C; Water level control and surveillance system.
+ Station 2: PLC S7-1200 CPU 1212C, Module SM1232 - 2AQ; system PLC - inverter - motor stabilizes the dynamic speed by PID algorithm
+ Station 3: PLC S7-1200 CPU 1214C; Product classification system by color.

The stations are communicated with the server according to the industry standard communication Ethernet through TP-Link network switch.

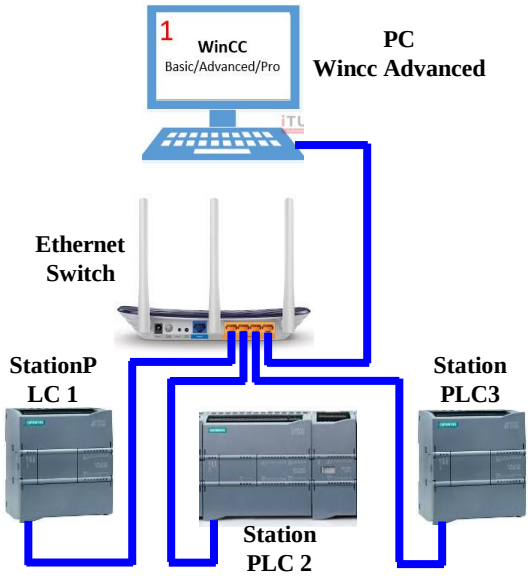

Figure 5. Diagram of control structure

Figure 5 shows the control structure diagram with IP addresses of stations, orderly:

Station 1: 192.168.0.1; Station 2: 192.168.0.2

Station 3: 192.168.0.3; Computer: 192.168.0.4

Declaring hardware configuration on TIA software as shown in Figure 6.

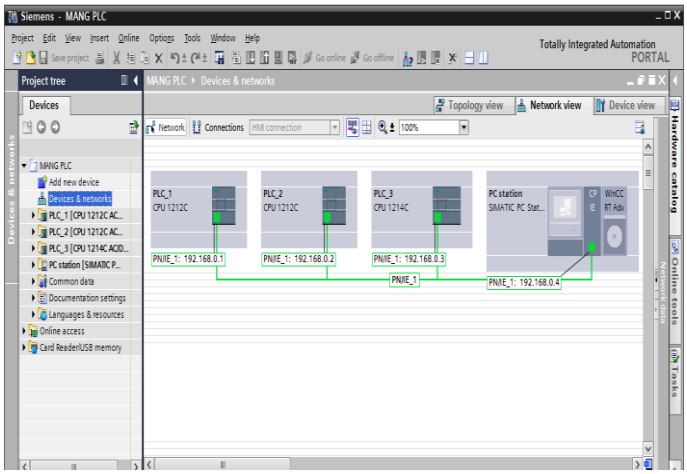

Figure 6. Hardware configuration on TIA Portal software

The program is written on the TIA Portal software, the surveillance control display is built on the Wincc Advanced RT platform built into the TIA Portal. Experimental model image is shown as figure 7.

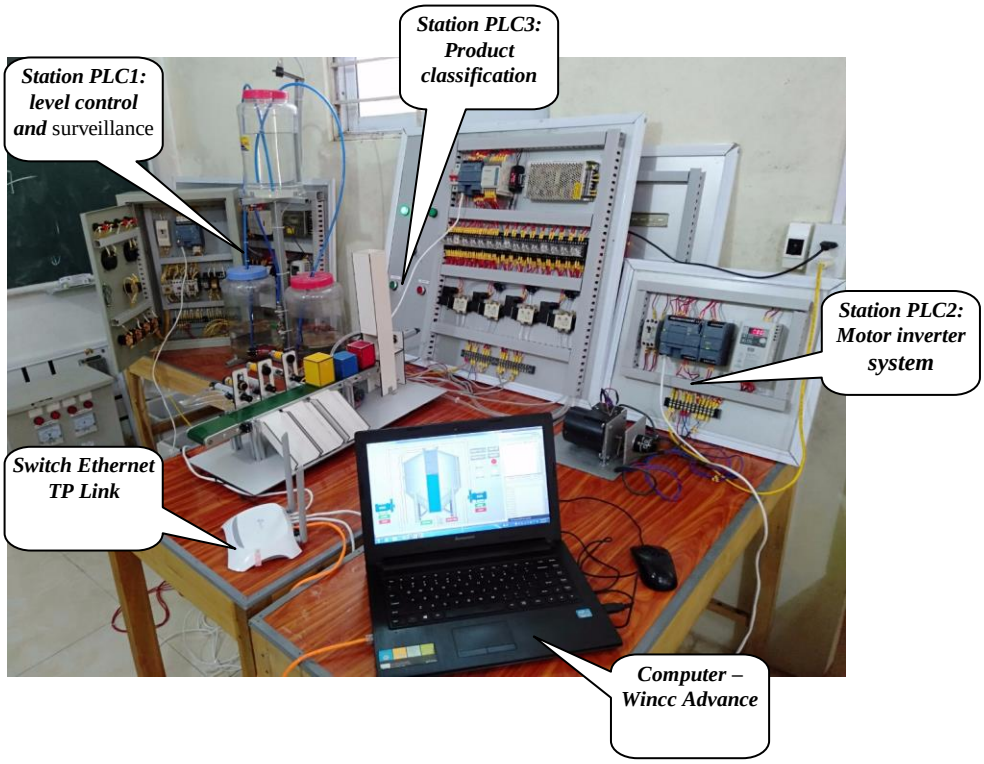

Figure 7. Systematic experimental model

V. EXPERIMENTAL RESULTS, DISCUSSION

3.1. Input / output figures

Station PLC1: Level control and surveillance system

Order	Name, specifications	Order	Name, specifications
1	Water level: 0 ÷ 30cm	5	Amount of pump: 2 cái
2	Low level warning: ≤ 5cm	6	Level sensor: LK6C/D2 – Out Analog 4 ÷ 20mA
3	High level warning: ≥ 25cm	7	Operating mode: Local /Remote
4	Pump power: 30W; Power 12Vdc/2A	8	Control mode: Automatic/Manual

Station PLC2: PLC - Inverter - Motor system

Order	Name, specifications	Order	Name, specifications
1	Inverter: LSIE5 100W; 220Vac	3	speed sensor: Encoder OMRON E6B2 – CWZ6C 1000x/v
2	Speed adjustment range: -1450 rpm ÷ 1450 rpm	4	Operating mode: Remote/Automatic

Station PLC3: Product classification system by color

Order	Name, specifications	Order	Name, specifications
1	Conveyor motor: TG35E - 35W; Voltage 24Vdc	4	Air compressor: Pressure MaX 0.7 Mpa
2	Cylinder: AIRTAC MAL 16x50	5	Color Sensor: Keyence CZ-V21
3	Air valve: AIRTAC 4V210	6	Operating mode: Automatic /Manual

3.2. Experimental results and conclude

Results of real running are shown as figure 8, figure 9, figure 10.

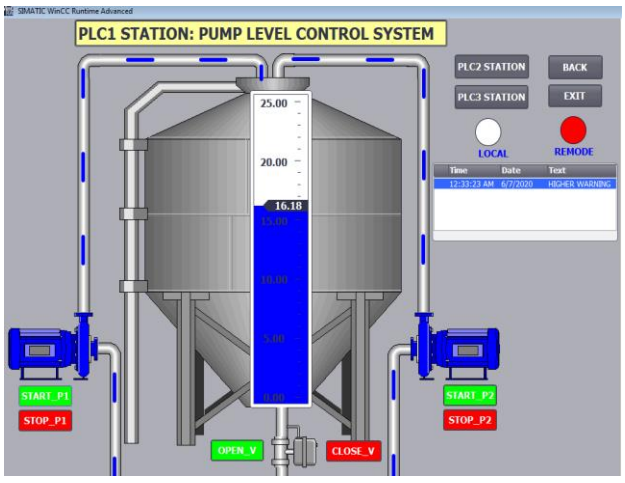

Figure 8. Level control and surveillance

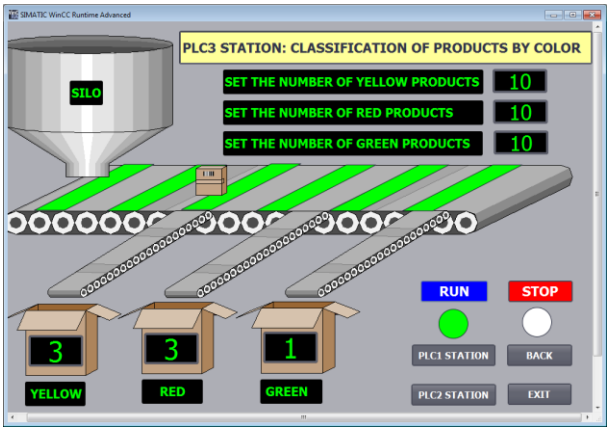

Figure 9. Product classification

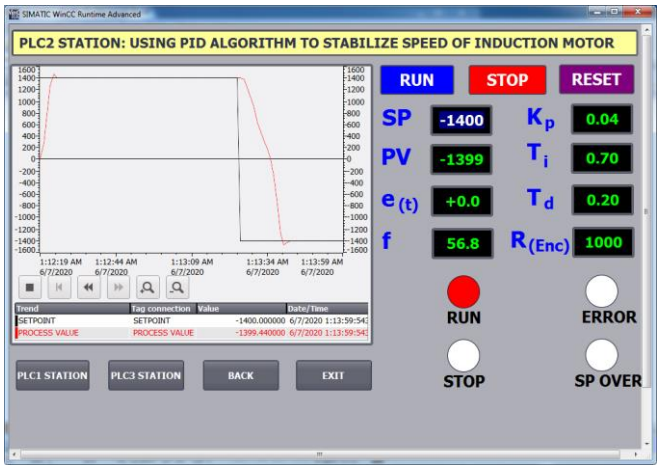

Figure 10. system PLC - Inverter - Motor when changing from 1400 to -1400 rpm

Experimental results show that Siemens S7 1200 PLC is equipped with Ethernet communication port so building hardware configuration as well as programming and building software interface is very simple. The transmission speed is large, so the system processes quickly, accurately, controls and monitors many different PLC stations at the same time. TIA Portal software integrates all tools: Programming, building display HMI, SCADA, DCS all in one, bringing convenience to design engineers.

VI. CONCLUSION

Scientific technology is developing day by day, through Industry 4.0, which requires automation systems in factories to be more flexible, convenient, and devices need to be networked to form a unity. Not simply control in place or in the central control room, but also need remote control via Internet - Internet of Thing (IoT). PLC S7 1200 was born with Ehternet standard and had extremely powerful software tools that have solved complex industrial problems well.

ACKNOWLEDGMENT

This research was supported by a grant for the university research from the TNUT (Thai Nguyen University of Technology). We thank our colleagues from the TNUT who provided insightand expertise that greatly assisted the research.

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