Development of PLC networking for communication with mobile phones

Jirawan Tasapark and Worapong Tangsrirat

Department of Control Engineering, Faculty of Engineering and
Research Center for Communication and Information Technology (ReCCIT),
King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
(E-mail: jirawanta@ap.omron.com , ktworapo@kmitl.ac.th)

Abstract : This paper presents the programmable logic controller (PLC) networking development for communication with the mobile phone. The proposed technique is suitable for remote sensing control systems, which can display the operation status and monitoring fault diagnosis of a system. The system operation is based on the use of personal computer (PC) to logically analyze data from PLC, and existing internet protocol for sending information messages to mobile phones.

Keywords : Programmable Logic Controller (PLC), automatic control system, remote sensing system

1. INTRODUCTION

Presently, a programmable logic controller (PLC) is widely used in many applications such as process control systems, instrumentation and measurement systems, especially in automatic control systems. The PLC-based automatic control system can offer the automation system that can be controlled remotely by using the remote I/O terminal to communicate with each area (node). Moreover, the PLC networking requires only 2- or 4-conductor signal cables for connecting and exchanging data with FA devices, such as PCs, or IT devices, such as personal computers. This means that the system greatly reduces wiring work, installation effort, and time for system maintenance and expansion. Recently, wireless automation systems have much received the attention. This is due to the fact that they are low cost to get started, easy to expand, and suitable for a variety of production styles, such as to control production in individual cells in cell manufacturing.

Therefore, the development of the PLC-based control system for wireless automation in mobile phone networks is proposed in this paper. The proposed technique can identify the system operation fault and report the operating status to the mobile phone via SMS text messages. The simulation of liquid level control system is designed and constructed in order to confirm the validity of the proposed control technique. The experimental results show that the obtained system becomes a wireless automation control system, which can remotely monitoring the system operating status through mobile phones. Finally, the proposed technique is also expected to be useful in a wide-covering wireless automation systems.

2. BASIC SYSTEM CONFIGURATIONS

The basic system configuration for communications with the PLC network is shown in Fig.1. With using PLC links, the system operation can be divided into three network levels, i.e., component network, controller network, and information network. For the component network communication levels, the PLC is used to control and connect the various control components, such as digital I/O module, analog I/O module, temperature controller, servo driver and bar code reader, via the DeviceNet network. The DeviceNet supports IT devices such as, personal computers (PCs) to access control devices setting and to reduce work hours. The controller network level provides a gateway that easily exchanges data between FA devices, such as PLCs, and IT devices through Ethernet. The information network is the top level of communications. This allows sending PLC's data to the server, and also enables a PC in the head office, remote office, home, or on business trips, to monitor the system in operation and the settings of each device, therefore easily allowing the centralized monitoring of the network. This decreases the setup time of the system, allows improvements in system expandability, and provides ease of system maintenance.

A possible application for telecommunications based on the basic PLC network communication of Fig.1 can be shown in Fig.2. In this case, the protocol support tool is composed of middle ware, active X control and gateway, which is the software for creating a procedure or protocol for sending and receiving data to or from general-purpose external devices through RS-232C or RS-485/422. A protocol consists of a set of communications sequences that constitutes several steps and allows the user to iterate, branch, or end these steps according to the result of the process. The PC function as a server connected to an internet explorer for accessing mobile phone database.

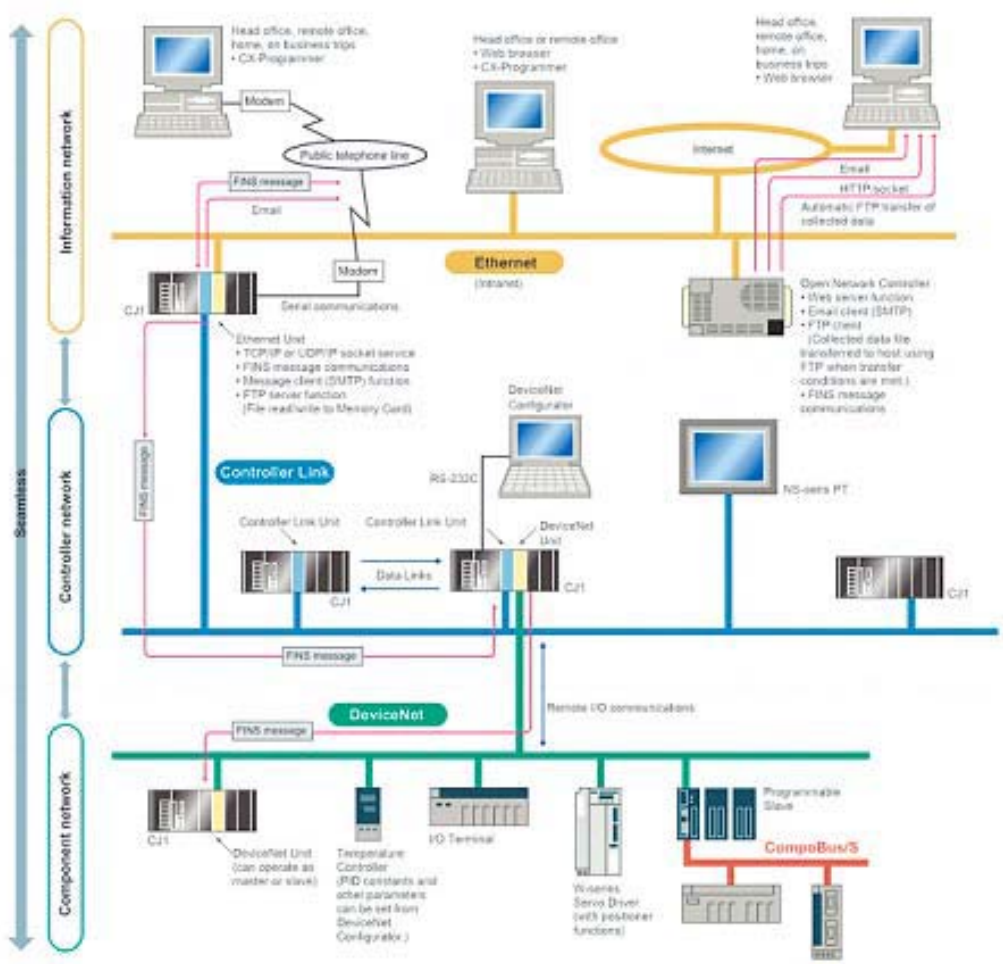

Figure 1 : PLC network communications

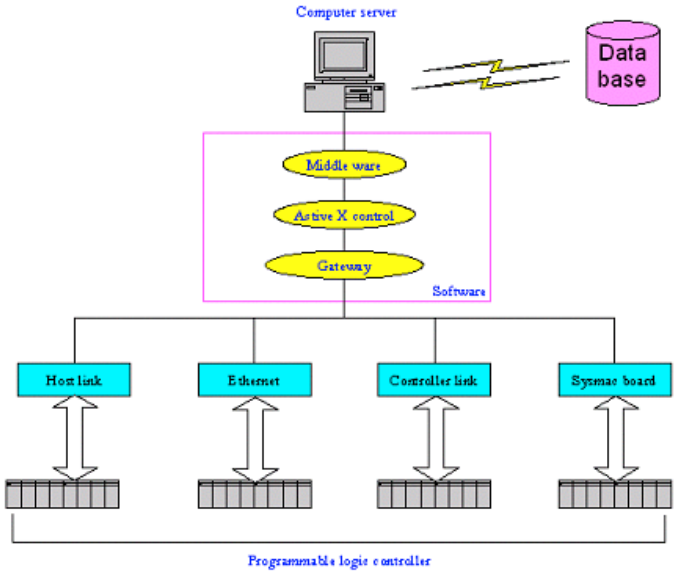

Figure 2 : A possible PLC-based network for telecommunications

3. PROPOSED PLC NETWORKING SYSTEM

In order to enable a PC in the system to monitor the system operation and the settings of each device, the DeviceNet (CompoBus) network configuration shown in Fig.3 is used [1]. The DeviceNet, developed by Allen-Bradley, Inc. of the U.S.A., is an open field network that can connect to a wide range of I/O lines, analog signal line and communication lines (e.g., RS-232C and RS-422). The DeviceNet is a multi-bit, multi-vendor network that combines controls and data on a machine/line-control level. Two types of communications are supported: 1) remote I/O communications that automatically transfer between slaves and the CPU unit without any special programming in the CPU unit, and 2) message communications that read/write messages, control operation, or perform other functions for master units, CPU units to which a master unit is mounted, or slaves. Message communications are achieved by executing specific instructions from the program in the CPU unit. This allows the DeviceNet network to be used as a common bus to unify control while reducing wiring.

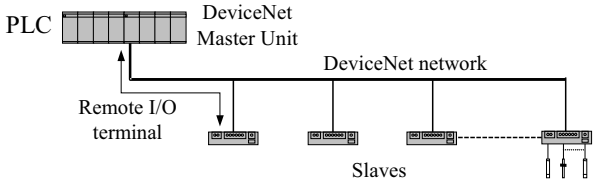

Figure 3 : DeviceNet network configuration

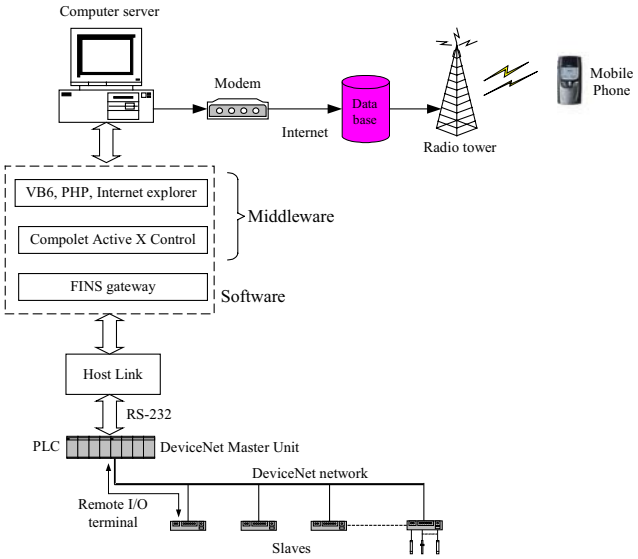

Figure 4 : Proposed PLC networking system

According to the basic concept of the system configuration of Fig.2 by employing DeviceNet network, the proposed PLC networking development system for communicating with mobile phones, which is suitable for the remote sensing control system, can be shown in Fig.4. A computer server used in this system functions as a central processing unit for sending, receiving and monitoring data from system operation, as well as connecting to an internet explorer. For the communication between PLC and computer server, the host link protocol is employed via RS-232 serial cable, and using the FINS gateway as a software driver [2-3]. The Compolet program, which is an active X control, is the command format for the sending or receiving commands from PLC [4-5]. For the middle-ware, it consists of Visual Basic 6 (VB6), PHP Hypertext Preprocessor (PHP) together with internet explorer. VB6 will maintain the PLC data using command format form Compolet active x control program, and send to PHP, which processes for the web server. By using the internet explorer, the processing results from PHP are then sent the status of the system operation to the mobile phone through the web browser.

4. EXPERIMENTAL RESULTS

In order to verify the control operation of the proposed PLC networking system for wireless automation in mobile phone networks, the liquid-level control system depicted in Fig 5 is used as a system under control. In this configuration, the configurator is a software application, VB6, running on a PC that operates as one node in the DeviceNet (Compobus) network, allowing message communications between PC and internet database. When the PB-START is pressed, the motor pump will be operated and the green lamp will also be "ON". In the other hand, if the PB-STOP is pressed, then the red lamp will be "OFF" indicating the stop operation of motor pump, where the level of the liquid in the tank is detected by using level sensor.

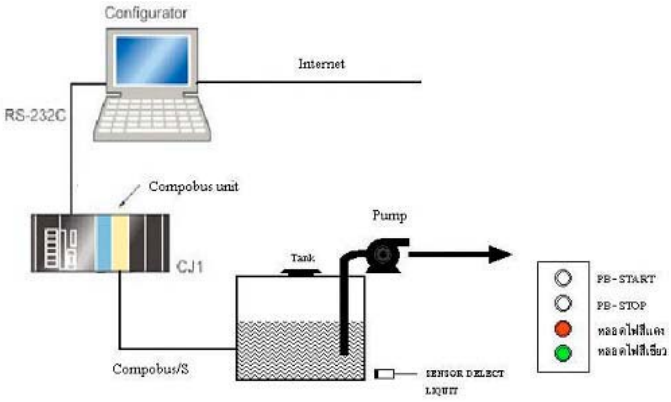

Figure 5 : Liquid-level control system using DeviceNet network

Referring to the DeviceNet network configuration of Fig.3, the node numbers of the input/output slave must be set up. The beginning word is begun at address 2000, 16 bits/address, listed as the ladder commands below.

Address output slave node: 0	2000.00	Motor pump
	2000.01	Lamp red
	2000.02	Lamp green
	2000.08-2000.15	Input slave error flags
Address output slave node: 1	2004.00	PB-START
	2004.01	PB-STOP
	2004.02	Level-liquid sensor
	2009.08-2009.15	Output slave error flags

Fig.6 illustrates VB6 editor PC program configured the control application for monitoring PLC status and sending PLC data to the mobile phone. In the experimental, if the system has a fault diagnosis or the system cannot operate properly. The operating status of the PLC will be sent to the mobile phone through internet system by VB6 program. The VB6 user interface screens showing the resulting operation of the system are shown in Figs.7 and 8, respectively.

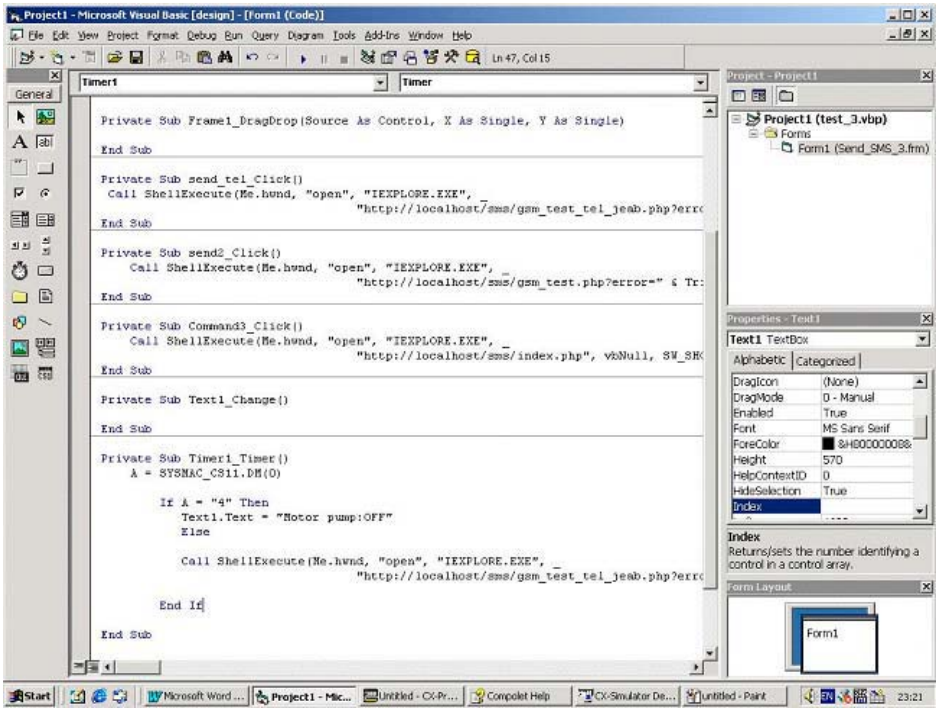

Figure 6 : VB6 editor PC program

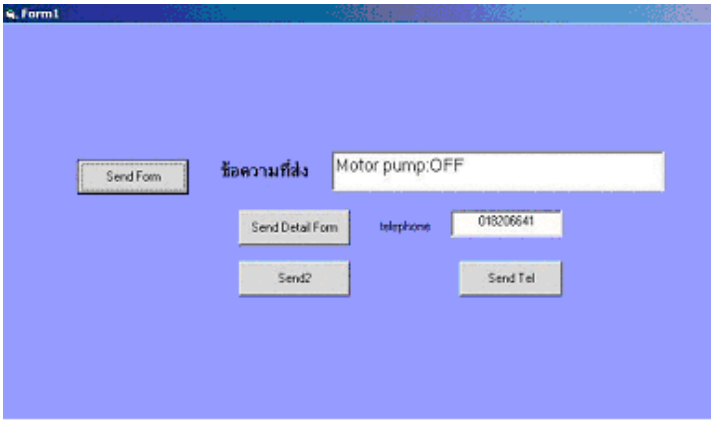

Figure 7 : Sending text message to the mobile phone

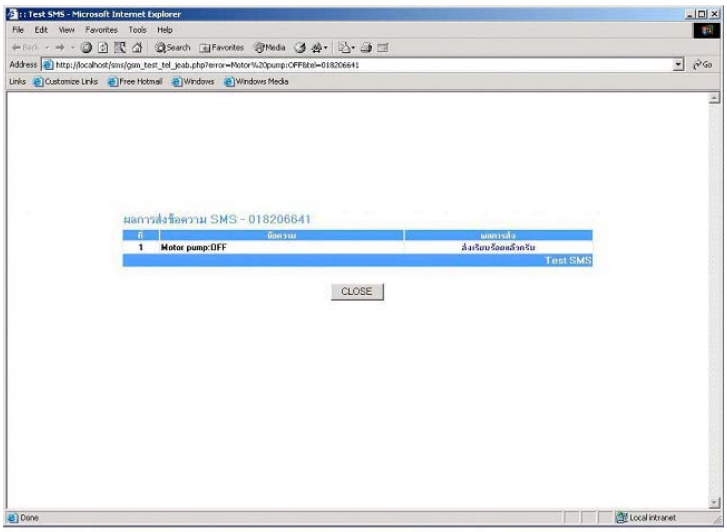

Figure 8 : Resulting message after sending

5. CONCLUSIONS

In this paper, the development of the PLC-based network configuration suitable for the wireless communication with mobile phones is proposed. The system configures, transfers, secures, reports and interfaces the text messages of the system operation from the PLC-based networking to mobile phones. Furthermore, the proposed system is also expected to be useful in a wide range of wireless automation applications such as, machine and device controls and remote monitoring, pumping and water handing applications, energy and network controls, measuring and SCADA type remote controls, industrial and building and vehicle automation.

REFERENCES

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