

REAL EQUIPMENTS LABORATORY AND MODELS REMOTE CONTROL VIA PROGRAMMABLE CONTROLLERS

SYSALA, T[omas]

Abstract: The paper is focused on description of remote control of laboratory models that are used in the process of education at our faculty. The models are connected to programmable logical controllers (PLC) and through these equipments the models are controlled. As the first step the students have to connect the model to a PLC. With that they have to make a program for mode control and they must verify its functionality. The last step is the visualization of the process control in some commercial SCADA/HMI systems. There are also described possibilities of remote control in the paper. Examples of all these cases are presented in this contribution.

Keywords: real control, PLC, education, remote control

1. INTRODUCTION

Curriculums at our faculty are specialized on applied informatics and control of technological processes. Our students attend several different mainly theoretical courses specialized on the control theory like the Automatic control theory, System simulation, System identification, Measurement and control of technological processes.

With that they pass through mainly application courses like Microcomputers and their applications, Programmable logical controllers and others in which they apply its knowledge from preceding courses. In this application courses students have to know the measurement method, they must know types of sensors for temperature measuring and for pressure, speed, power and liquid level measuring (Sysala at al., 2006).

In PLC course the teacher determinates a model to control and a control method. Students must make the controller proposal and then they can implement it into control software of a PLC. For this they must can its programming system and its programming language. If the application appears functional the student must do project in some visualization SCADA/HMI software.

The main tasks for students are:

- to analyze number and category of inputs and outputs (digital I/O, analog I/O, etc.),
- to connect a model to PLC, if it is not connected.
- to propose a control algorithm and to implement it into PLC memory,
- to make a project in some SCADA system (InTouch, Control WEB, WizCon).

2. REAL MODELS

There are several models in our laboratory for programming PLC education. There are models of real equipments and models based of microcontroller. The models from both groups are connected to PLC and optionally from PLC to PC.

2.1 Models based on microcontroller

All models from this group look very similar. They consist from the board with microcontroller where is stored a program

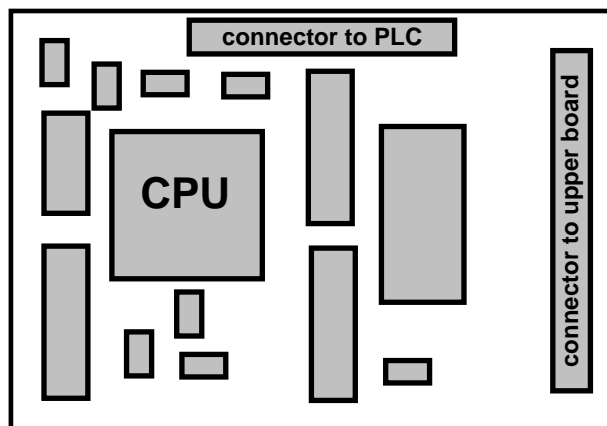


Fig. 1. The lower board with microcontroller

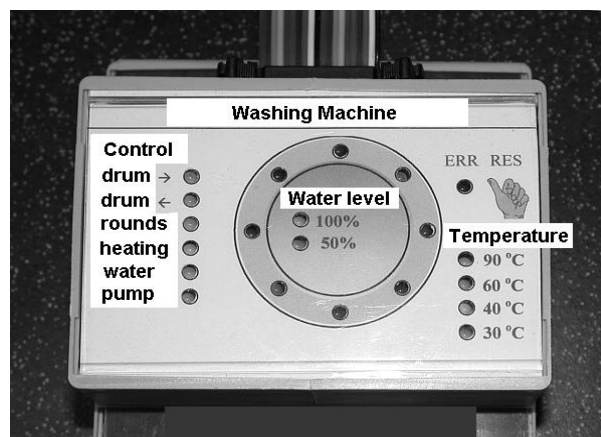


Fig. 2. The washing machine upper board

(Figure 1), board with LED diodes (Figure 2) and a connector and a cable to PLC connection. A program simulates behaviour of some real equipment. It reads inputs (outputs from PLC) and sets outputs (inputs to PLC), so the PLC doesn't detect if the signals send a model or real equipment (Kohout, 2004).

For example: A washing machine model – PLC send a signal “heating”, “rotation left or right”, “wring”, etc. The model sends back to PLC water temperature and water level.

There is the second board above the board with microcontroller. There are several LED diodes on the upper board and these diodes indicate all inputs and outputs and schematically represented simulated device.

There are these models at our laboratory:

- washing machine,
- interfluent unit,
- cross-roads,
- moveable conveyer,
- display with seven LED segments for number representation.

2.2 Real equipment models

The second group is group of real equipment models. Each model is connected to PLC and we can control all inputs and measure all outputs of the model.

There are these models at the laboratory:

- elevator model,
- railway model,
- small fountain,
- family house model (Dvoracek, 2007),
- ball levitation on a water column (Vrzal, 2008).

3. PROGRAMMABLE CONTROLLER SAIA DESCRIPTION

All models are controlled by PLC SAIA, the product of Saia Burgess Company. It looks like modular PLC and it is suitable for smaller task from the technological process control sphere, but it can be complement up to eight different modules (binary inputs, binary outputs, analog inputs, analog outputs, communicating modules, etc.). (Saia, 2005). In the laboratory we use PLCs Saia – model family – PCS1 (model PCS1.C622), PCD2 (model PCD2.M140), PCD3 (model PCD3.M5540).

The PCD3 model family offers more possibilities than PCD2. The model family PCS1 is simpler, but we have got a model, where is implemented a module MC35. This module offers receiving and sending of Short Messages (SMS).

It is a recommended programming tool PG5 for making a program for SAIA@PCD. Whole system is organizing by files (containing several program blocks) simplifies the shared use of program files between several SAIA@PCD controllers.

Each file and each part of program can be made via various techniques:

- FUPLA (function block diagram),
- S-Edit (instruction list IL),
- GRAFTEC (sequential function chart).

The Fupla editor is the simplest, fastest introduction to programming PCD controllers. The name "Fupla" means "FUNCTION PLAN", a graphical programming environment in which the user raw programs with the aid of hundreds of functions. GRAFTEC environments better for sequential programming. The program in GRAFTEC is created by transition conditions and steps what each other change and the program runs step by step on defined conditions (Saia Burgess, 2005).

4. REMOTE CONTROL

There are several possibilities how to change some parameters to process control stored in PLC memory. Some of them are described hereafter.

4.1 HMI Panel

HMI panel – Human Machine Interface panel is the easiest way to change parameters in the PLC. But this way has a disadvantage – we have to be close to control PLC, so it is not exactly remote control. But if we have a microbrowser (terminal) with own IP address and if it is connected to Internet, we can read and set all PLC inputs and outputs from all over the world.

4.2 RS232, RS485

The other way is to use classic communication through RS232 or RS485. This way is used if PLC has only these types of communication ports. We use this way if we have got some older PLC. A PLC is connected to a personal computer or to some other recent PLC type. Through this device we have access to all inputs and outputs of the first PLC.

4.3 Internet, Intranet access

Current data PLC enables to create distributed industry nets. All devices in this net have dedicated address, so we can send data to arbitrary PLC in this net. If our net is an industry net we use communication through a bus. It is a Profi-Bus, S-Bus, ModBus or more other protocol used. If we have a PLC connected to Internet we mostly use a TCP/IP protocol.

4.4 GSM Communication

If we don't have connection to Intranet or Internet and we have no possibilities to connect the controlled process to control room via wire, we can use a GSM module set in PLC. Through this device we can send or received "Short Messages" (SMS). It is possible to get a temperature or water level and other parameters of the control system and we can send SMS with control commands to the heating, water pump or other outputs in the PLC (Sobolík, 2007).

In our laboratory we have all of these described methods of communication between technological process and control room.

5. CONCLUSION

It was description our laboratory for education PLC programming. The students learn to program and to control real equipment models. They can use possibilities of remote control via personal computer or PLC or control through local computer.

The students are very interested in this course because:

- The models are and look very similar like real equipments.
- Students apply theoretical knowledge in real application.
- It is easy to see if application is working correct.
- They are prepared for working with programmable controllers and SCADA/HMI systems in the factories, in industry, in their new job in the future.

6. ACKNOWLEDGMENTS

This work was supported by the Ministry of Education of the Czech Republic under grant MSM 7088352102. This support is very gratefully acknowledged.

7. REFERENCES

- Dvořáček, J. (2007). Model domku monitorovaný a ovládaný programovatelným automate (A Family House Model controlled by PLC), *diploma work* (in czech), Tomas Bata University in Zlin, Faculty of Applied Informatics, 2007
- Kohout, L. (2004). Popis jednotlivým modelů řady EDU-mod, (Model EDU-mod description), (in czech), Ing. Ludek Kohout Company, Kutná hora, 2004
- Saia Burgess (2005). Saia-Burgess Electronics: *Hardware PLC – PCD1 a PCD2*, Edition 26/803 M2
- Sobolík, M. (2007): Nové laboratorní úlohy pro předmět Programovatelné automaty (New models for course Programmable Controllers), *diploma work* (in czech), Tomas Bata University in Zlin, Faculty of Applied Informatics, 2007
- Sysala, T.; Dostál, P. & Adámek, M. (2006). Monitoring, Measuring and Control Systems for Real Equipment Controlled by PLC in Education, IN: *XVIII IMEKO WORLD CONGRESS - Metrology for a Sustainable Development*, September, 17 – 22, 2006, Rio de Janeiro, Brazil, p. 9, section TC1
- Vrzal, O. (2008). Levitace balonku na vodním sloupci (A ball levitation on the water column), *diploma work* (in czech), Tomas Bata University in Zlin, Faculty of Applied Informatics, 2007

Copyright of Annals of DAAAM & Proceedings is the property of DAAAM International and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.