

REMOTE CONTROL OF THE LABORATORY MODELS THROUGH PROGRAMMABLE CONTROLLER

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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 controller (PLC) and through this equipment the models are controlled. There is explained process of building one of the models. As the first step the students have to connect the model to a PLC. PLC Saia are used, the product of Saia Burgess Company. Than they have to make a program to control the model and they must to verify its functionality. The last step is the visualization of the process control in some commercial SCADA/HMI systems.

The possibilities of remote control are also described in the paper. It is possible to control the model through serial interface RS 232, RS485, Internet or Intranet interface or through GSM mobile net. Examples of all these cases are presented in this contribution.

Keywords: real control, PLC, 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 Automation Control Theory, System simulation, System identification, Measurement and control of technological processes.

Than they pass through mainly application courses like Microcomputers and their applications, Programmable Logical Controllers (PLC) and others in which they apply its knowledge from preceding courses. In these 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 [2, 3].

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 know 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 model to PLC, if it is not connected.
- to propose a control algorithm and to implement it into PLC memory,
- to make an 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 of microcontroller

All models from this group look very similar. They consist of the board with microcontroller where the program is stored, board with LED diodes and a connector and cable to PLC connection. A program simulates a behavior of any real equipment. It reads inputs (outputs from PLC) and sets outputs (inputs to PLC), so the PLC doesn't detect whether the signals are sent by the model or a real equipment. There is the second board placed above the board with microcontroller

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

There are on the upper board several LED diodes and these diodes indicate all inputs and outputs and schematically represented simulated device [2, 3].

There are these models at our laboratory:

- washing machine (Fig. 2),
- interfluent unit (Fig. 1),
- cross-roads ,
- moveable conveyer,
- display with seven LED segments for number representation.

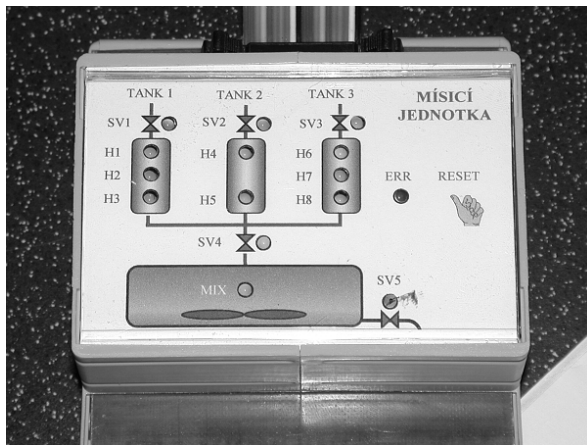


Figure 1. Interfluent unit model based on microcontroller



Figure 2. Washing machine model based on microcontroller.

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.



Figure 3. Small fountain

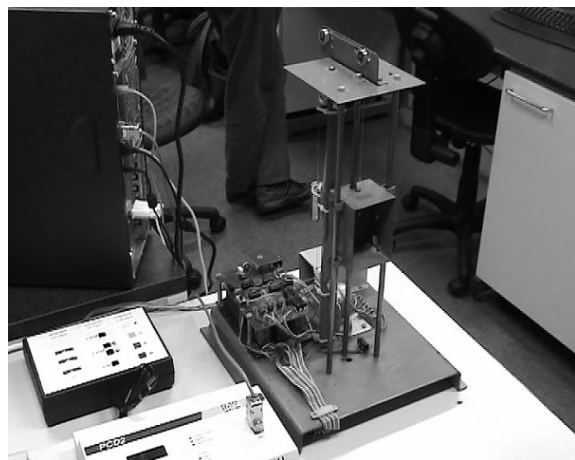


Figure 4. Elevator model

There are these models at the laboratory:

- elevator model (Fig. 4),
- railway model (Fig. 5),
- small fountain (Fig. 3),
- family house model (Fig. 6).



Figure 5. Railway model



Figure 6. Family house model

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 extended up to eight different modules (binary inputs, binary outputs, analog inputs, analog outputs, communicating modules, etc.) [1]. In the laboratory we use PLCs Saia – model family – PCS1 (model PCS1.C622), PCD2 (model PCD2.M140), PCD3 (model PCD3.M5540).

Main properties and parameters of the SAIA PCD2 model:

- Central inputs/outputs - fit with any 8 I/O modules for up to 128 I/Os, additional 4/8 I/O module socket via expansion housing for up to 255 I/Os,
- User memory for programs, texts and data blocks - 1 MByte RAM in basic assembly,
- Flash-card - 1 MByte for backup the user program,
- Processing time - 2 μ s bit processing, 10 μ s word processing,
- Fast counters and interrupt inputs - 2, for interrupts or counting up to 1 kHz,
- Serial data port (PGU connector) - 1 \times RS 232 with RTS/CTS or RS 485 electrically connected,
- Serial data ports - 1 \times RS 232 (suitable for modem connection)/RS 422/RS 485 or 2 \times RS 232,
- Field bus connection - PROFIBUS FMS, PRO FI BUS DP as master or slave, LONWORKS®,
- Ethernet-TCP/IP network connection - 2 \times PROFIBUS DP as slave or 2 \times LONWORKS®.

These were properties and parameters of the SAIA PCD2 model family. The PCD3 model family offers more possibilities. 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).

The programming tool PG5 is recommended for making a programs 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 of each part of the program can be made with the use of 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 draws 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 [1].

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. The disadvantage of this device is we have to be close to control PLC, so it is not a remote control.

4.2. RS 232, RS 485

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 a 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 a connection to Intranet or Internet is not available 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 receive “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 [4].

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

5. CONCLUSION

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

The students are very interested in this course because:

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

6. ACKNOWLEDGMENT

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

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