A real models laboratory and an elevator model controlled through programmable controller (PLC)

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Abstract: - The paper is focused on description 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 model control and they must verify its functionality. The last step is the visualization of the process control in some commercial SCADA/HMI systems.

Key words: - real control, PLC, education, elevator, real equipment models, automatic 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 trough 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 [4].

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, board with LED diodes for equipment simulation and a connector and a cable to PLC connection.
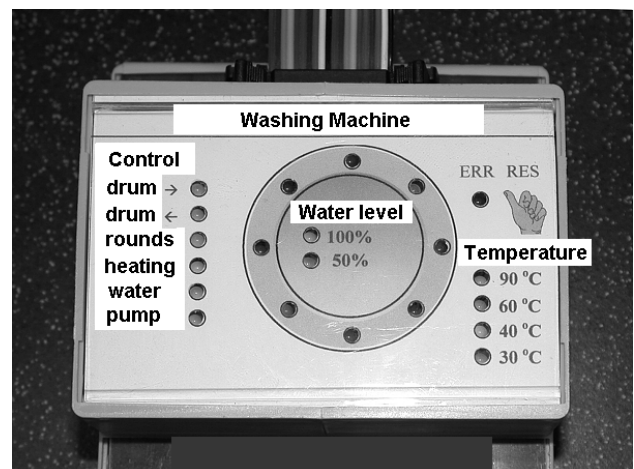

Fig. 1 Example of a model based on microcontroller – A washing machine

A microcontroller 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 [2].

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 are these microcontroller models at our laboratory:

- washing machine,
- interfluent unit,
- cross-roads,
- autoclave,
- 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 (1 cab, 3 floors),
- railway model,
- small fountain,
- family house model [1],
- ball levitation on a water column [6],
- elevator model (2 cabs, 5 floors).

Fig. 2 A family house model

3 Elevator model description

he newest model in our laboratory is an elevator model with 2 cabs and 5 floors (Fig. 3).

Fig. 3 Workplace with an elevator model

Fig. 4 A photo of workplace with an elevator model

Whole workplace consists from these parts:

- computer table,
- computer for PLC programming or for elevator monitoring,
- elevator model,
- separated panel for cab control panel simulation,
- control PLC Tecomat FOXTROT.

Basic characteristic of the elevator model:

- 2 cabs (cars),
- 5 floors,
- 2 eletric motors for each cabs,
- 10 small electric motors for each door,
- 2 buttons and 2 LED diods (cab annunciator) on each floor,
- 12 buttons and 12 LED diods for control panel annunciator.

Altogether are used 30 binary inputs into PLC and 36 binary outputs from the PLC.

This model is used mainly for PLC programming education. Students learn to program PLC per instruction list (IL) or per lader diagrams (LD). These methods they use for basic tasks like "send left cab to fifth floor" or "wait for door closing and send right cab to first floor", but elevator control is a typical task for sequential control.

With sequential control in this case the PLC controls both cabs by transition conditions and steps what each other change and the program runs step by step on defined conditions. It is different and also modern method for effective control of equipment hereof task type [7].

In the last step it is optionally possible to monitor all inputs and outputs from/into PLC in some SCADA/HMI system from local PC or through Internet from anywhere in the world.

4 Control PLC

For elevator control is used PLC type Tecomat FOXTROT CP 1005 by Czech company Teco, a.s., Kolin. This PLC is suitable for smaller task from the technological process control sphere.

It looks like compact controller, but it can be complement up to ten different modules (binary inputs, binary outputs, analog inputs, analog outputs, communicating modules, etc.) [5].

Some basic features of PLC FOXTROT:

- Programmable controller (PLC) according to IEC EN 61131.
- 6 inputs alternate binary inputs and analog inputs.
- 6 relay outputs in two groups on board.
- On-line programming
- Programming and data communication (in LAN, WiFi, WAN, Internet) is available on Ethernet port (100 Mbps) with fi xed IP address.

5 Conclusion

It was description our laboratory and the elevator model for PLC programming education. 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 a 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 Acknowledgment

References
[1] J. Dvořáček, 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 Aplied Informatics, 2007.

[2] L. Kohout, Popis jednotlivým modelů řady EDU-mod, (Model EDU-mod description), (in czech), Ing. Ludek Kohout Company, Kutná hora, 2004.

[3] M. Sobolik, Nové laboratorní úlohy pro předmět Programovatelné automaty (New models for course Programmable Controllers), *diploma work* (in czech), Tomas Bata University in Zlin, Faculty of Aplied Informatics, 2007.

[4] T. Sysala, P. Dostál, M. Adámek, 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, 2006.

[5] Teco, http://www.tecomat.com – Tecomat FOXTROT, *Accessed on: 2010-09-10,* 2010.

[6] O. Vrzal, Levitace balonku na vodnim sloupci (A ball levitation on the water column), *bachelor work* (in czech), Tomas Bata University in Zlin, Faculty of Aplied Informatics, 2008.

[7] O. Vrzal, Sekvenční řízení modelu výtahu programovatelným automatem (Sequence control of elevator model by programmable logic controller), *diploma work* (in czech), Tomas Bata University in Zlin, Faculty of Aplied Informatics, 2010.