LABORATORY FOR PROGRAMABLE CONTROLLER PROGRAMMING EDUCATION

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ABSTRACT

The paper is focused on description of two laboratory models which are used in the process of education at our faculty. Both models are connected to programmable logical controllers (PLC) and through these equipments all models are controlled. The first model is a model of a family house, the second one is a elevator model. As the first step the students have to connect the models to a PLC. It is used PLC Saia, the product Saia Burgess Company. With that they have to make a program to control of 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.

Keywords: laboratory model, PLC, real time, visualisation, real equipment.

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.

With that they pass trough mainly application courses like Microcomputers and their applications, Programmable Logical Controllers (PLC) 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 [4,6,7].

The teacher determinates the control method and the students must make the controller proposal. At first in Matlab environment and then they can to implement it into control software of real equipment. For this he must to choose device for control system. It can be microcomputer, personal computer, PLC and so one. He must can its programming system and its programming language. If the application appears functional the student must to do project in some visualisation software. Thank this software it is better to see process of a model control and it is possible to monitor all inputs and outputs of a control device as well as parameters of controller in each sample period.

The main tasks for students are:
- to analyse number and category of inputs and outputs,
- to connect model to chosen device,
- to propose a control algorithm and to implement it into device memory,
- to make an project in some SCADA system (InTouch, Control WEB, WizCon).

2. REAL MODELS

There are several models in our laboratory for real process control education. Two of them are described in this contribution. There are a family house model and a elevator model.

2.1. Family House model

The first model is a family house model. It consists of two main parts – building and control panel. There are many active elements and sensors in the building. In windows are open window detectors, next sensors are in doors, in swimming pool and there are the motion detection and limit switches, too. Through the control panel we can control lights in each room, ventilators in toilet and in the kitchen, water level in swimming pool, opening of garage doors etc. In the living room we can measure and control a temperature [8].
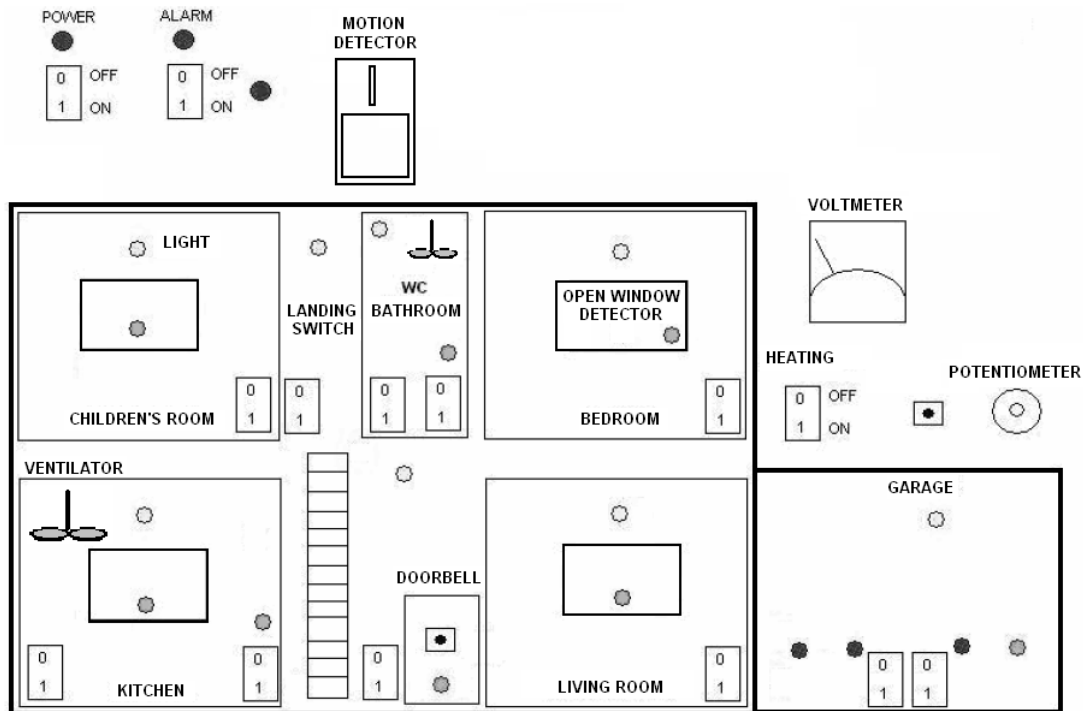

Figure 1. Active elements in family house model

Table 1. List of active elements in family house model

23 binary inputs (from the model to PLC)	31 binary outputs (from PLC into the model)
• light switches	• lights in all rooms
• ventilator switches	• alarm lights
• limit switches	• ventilator
• motion detector	• doorbell
• open window detector	• LED indicators of all inputs and outputs on the control panel
• doorbell switch	
2 analog inputs	**1 analog output**
▪ reference temperature	▪ signal to the potentiometer on the control panel
▪ real temperature	

2.2. Elevator model

The second model is elevator model. We can control the cab box moving through a control panel. The control panel contains two parts. The first one is simulating outsider push buttons on the each floor, the second part is simulating the control panel in the cab box. The cab box is able to move from first-bottom floor along second one to third floor and backward [9].

3. PROGRAMMABLE CONTROLLER SAIA PCD2 DESCRIPTION

Both models are controlled by PLC SAIA PCD2, 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.)[3].
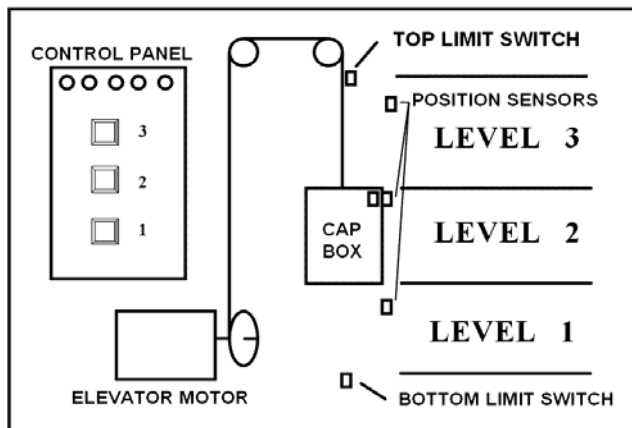

Figure 2. Elevator model scheme

Figure 3. PLC SAIA PCD2

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 μs bit processing, 10 μs word processing,
- *Fast counters and interrupt inputs* **-** 2, for interrupts or counting up to 1 kHz,
- *Serial data port* (PGU connector) - 1× RS 232 with RTS/CTS or RS 485 electrically connected,
- *Serial data port* **-** 1× RS 232 (suitable for modem connection), RS 422/RS,
- *Serial data ports* **-** 1× RS 232 (suitable for modem connection)/RS 422/RS 485 or 2× RS 232,
- *Field bus connection* **-** PROFIBUS FMS, PRO FI BUS DP as master or slave, LONWORKS®,
- *Ethernet-TCP/IP network connection* - 2 × PROFIBUS DP as slave or 2 × LONWORKS®,

It is recommended a programming tool PG5 for making new 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 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 raws programs with the aid of hundreds of functions. These functions are organized into libraries covering the basic applications, with more specialized functions added for certain professional domains. The special libraries include: a HEAVAC library for heating, ventilation and air conditioning, a modem library for networking PLCs to exchange data via telephone line (analog, ISDN, GSM, GPRS), the messages SMS, Pager and DTMF. Other libraries for communications networks LON, EIB or Belimo products are available too [3].
For family house control program was used the FUPLA environment only, for elevator control were used the FUPLA and GRAFTEC environments. GRAFTEC is 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. The control of elevator it is a typical task from this area.
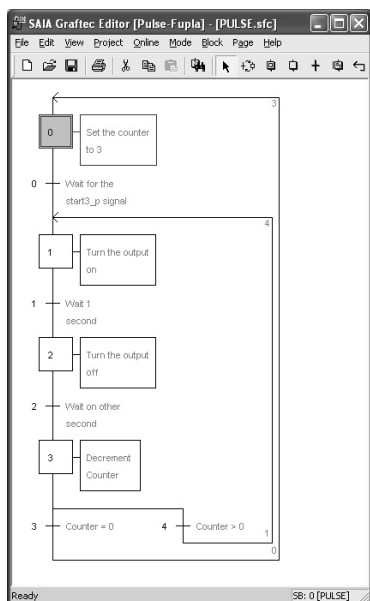
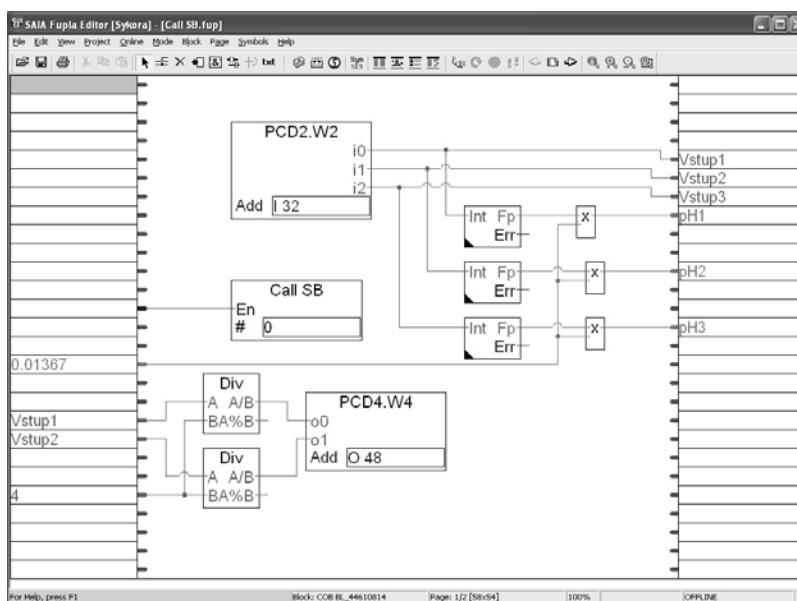*Figure 4. Part of a program made in GRAFTEC environment*

Figure 5. Part of a program made in FUPLA environment

4. CONCLUSION

It was description of two from some models in our laboratory for education PLC programming.
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 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.

5. ACKNOWLEDGMENT

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