

Design of Simulation Platform based on Soft PLC and Its Application in Mat lab

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Abstract. A design method of simulation platform based on soft PLC was proposed, in which Step 7, WinCE and Mat lab was used to accomplish the configuration of logic programs, HMI and plant model. OPC and other interface were used to implement data exchange for real-time simulation. With the help of the simulation platform, many innovation experiments were developed for practical teaching. And a foundation was laid for applied technique-oriented professionals' cultivating.

Introduction

The construction of application-oriented institutes has already begun since 2014, which is quite important for integration theory with practice, training exploring spirit and innovation consciousness, enhancing students' professional skills^[1]. Establishment of innovation experiments is the core of practical teaching^[2]. While in most cultivate scheme, comparing to the amount of innovation experiments, experiments are still dominated by the type of basis and integrated.

Technology of Programmable Logic Controller (PLC) is foundation course for most major of automation engineering and electrical engineering, which is quite important for students' education^[3-5]. Thus, in order to increase the amount of innovation experiments, push forward the reform of practice teaching process, a design method of simulation platform on soft PLC was proposed, and with the help of the platform, many innovation experiments were developed. The content of the experiments were all about research of configuration logic programs, designing of human machine interface (HMI), establishing plant models and application of communication, which could strength the project practice ability, cultivate the innovation sprit, and guide the lead to master scientific research method.

The method was applied in practical teaching process, and examined by 134 students and 536 hours of class. The result shows quite good effect for cultivation of talents.

Situation and analysis of PLC teaching

Experiment device based on hardware-in-loop simulation. PLCs are important basis for modern industrial, which are the control center in field of production^[6-7]. At present, there are two platforms for studying PLC technology. One of them is hardware-in-loop simulation experiment device as shown in figure 1.



Fig.1 Experiment device based on hardware-in-loop simulation

PLCs are the core of these experiment devices. Besides that, LED, switch, buzzer are also used to accomplish the simulation of industrial or daily life. Students should accomplish logic program to control these device. A typical application of this kind of experiment device is traffic light control simulation, as shown in figure 2. There are four groups of LEDs with each group containing red, yellow, and green LEDs, which represent traffic lights in every direction. Students can learn the use of PLC timer through the experiment.

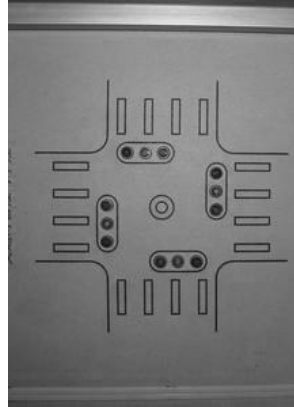


Fig.2 Traffic light control simulation

The digital control is the main type of these experiment devices. The experiment contents are highly simplified practical production, whose logic programs are simple.

Experiment device based on FMS. Experiment devices based on FMS are another devices used for PLC technology learning, which simulate the whole process of production, including feeding, transportation and other sectors, as shown in Figure 3.

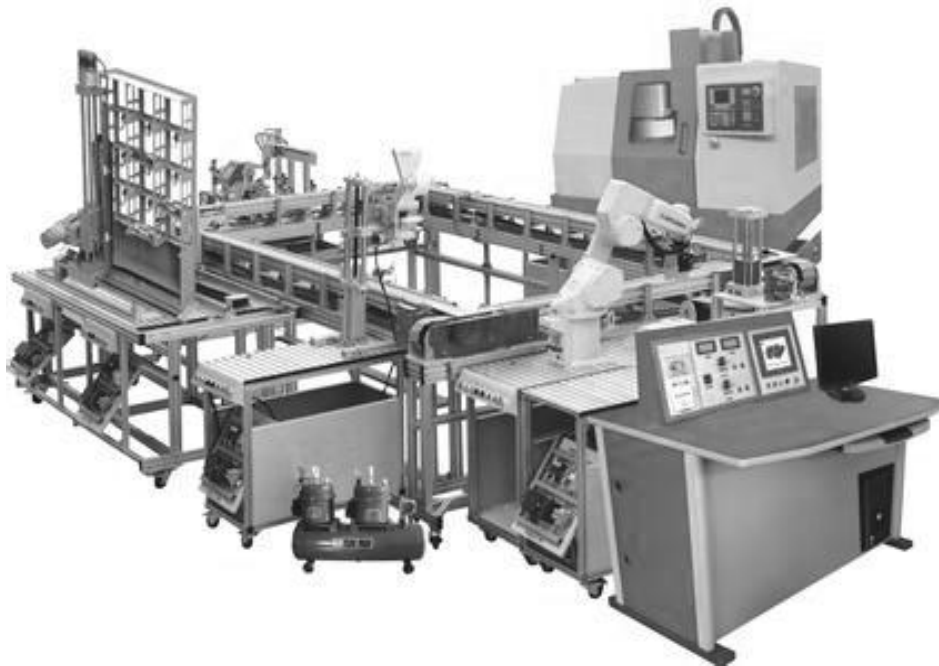


Fig.3 Experiment devices based on FMS

Compared to experiment device based on hardware-in-loop simulation, the logic programs are much more complex, and coordinated control should be consider between different control loops. Moreover, analog control should be needed besides digital control.

Situation for PLC teaching. Any of the experiment devices mentioned above can meet the requirements of basis and integrated experiments. But because of the limited of hardware, the development of innovation experiments is difficult.

In addition, designers should not only know how to write logic programs, but also should understand the characteristic of plant and the design of HMI. But the experiment devices mentioned above can't meet the requirement.

Design of Simulation platform based on soft PLC

Step 7, Mat lab and WinCE are used to construct soft PLC simulation platform in this paper. They are used for writing logic programs, constructing plant model, and designing HMI. Communication of the three software can be realized by OPC interface.

In the simulation platform, soft PLC integrated in Step 7 is used to transfer command to model in Mat lab, and receive the model's response. WinCC monitors and displays all the parameters of the system. Real-time simulation is used in the platform.

Figure 4 shows logic programs which accomplish the control of 4 flow loops, 3 pressure loops, 2 temperature loops and 2 level loops.

```

A      "Pump101PID". MA          DB2.DBX0.0
=      L      20.1
ELD   103
A      "Pump101PID". P_SEL       DB2.DBX0.1
=      L      20.3
ELD   103
A      "Pump101PID". I_SEL       DB2.DBX0.2
=      L      20.4
ELD   103
A      "Pump101PID". D_SEL       DB2.DBX0.3
=      L      20.7
ELD   103
CALL  "CONT_C", DB3              FB41
COM_RST :=
MAN_ON :=L20.1
FVPER_ON:=
P_SEL :=L20.3
I_SEL :=L20.4
INT_HOLD:=
I_INTL_ON:=
D_SEL :=L20.7
CYCLE :=
SP_INT :="Pump101PID". SP       DB2.DBD2
FV_IN :="Para".PI101           DB1.DBD0
FV_FER :=
MAN :="Pump101PID". MAN        DB2.DBD6
GAIN :="Pump101PID". P         DB2.DBD10
TI :="Pump101PID". I           DB2.DBD14
TD :="Pump101PID". D           DB2.DBD18
TM_LAG :=
DEADB_W :=
LMN_HLM :="Pump101PID". HI_Lim  DB2.DBD22
LMN_LLM :="Pump101PID". Lo_Lim  DB2.DBD26
FV_FAC :=
FV_OFF :=
  
```

Fig.4 Logic programs

Figure 5 shows plant model in Mat lab.

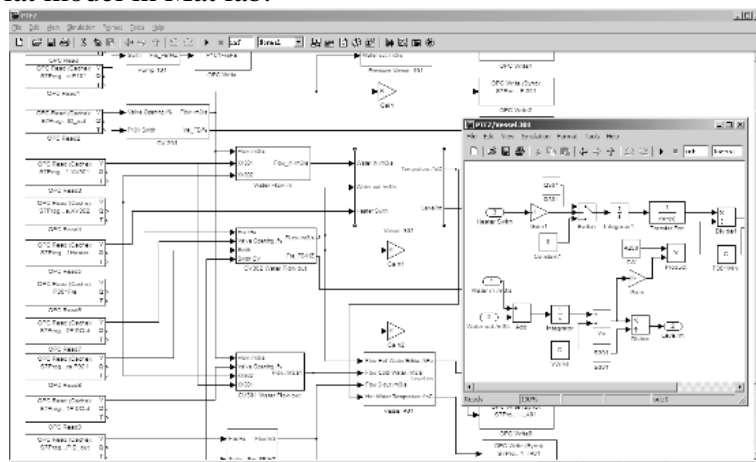


Fig.5 Plant model

OPC interface is used to accomplish communication for the three software. Besides designing of control logic programs and HMI, the simulation platform can also use for controller tuning.

Application of simulation platform in practical teaching

Innovation experiments for designing and researching of logic program. With the help of simulation platform, innovation experiments about designing control logic programs can be developed.

The designed logic programs in the simulation platform can be deleted. Students should analysis the function of the device, and write the missing logic programs to complete the project. In the progress, students should design the programs by themselves, which can enhance their ability of project design, and culture their innovation ability.

Innovation experiments for designing of HMI. Innovation experiments about designing of human machine interface based on WinCC can be development using the simulation platform.

According to the requirement of experiments, student should design HMI, display key parameters of the system, and send control commands. With the help of these experiments, the whole process of industrial design can be mastered, and the requirements of HMI design can be understood.

Innovation experiments for designing and researching of plant model. In industrial design, the ability of construct model of plant is required. Innovation experiments of model construct can be realized using simulation platform. In experiments, students should establish plant models and join the models with HMI to display key parameters. Thus students can understand their courses such as automation, detection technology.

Innovation experiments for designing and researching of controller tuning. The ability of controller tuning is important for students. Using simulation platform, students can discuss, research the methods of controller tuning. They should design the progress of controller tuning. The experiments can improve their engineering practice ability.

Conclusion

Based on the analysis of practical teaching about PLC, a design method of simulation platform based on soft PLC is proposed, and many innovation experiments are developed. The simulation platform was applied in practical teaching process, and examined by 134 students and 536 hours of class. The result shows quite good effect for cultivation of talents.

Reference

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