# Design of Robots Monitoring System on the Basis of Kingview

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***Abstract*—This paper introduces Robots Monitoring System on the Basis of Kingview. By using the device driver, Kingview acquires real-time data from on-site hardware device , whose results will be shown on the host computer's screen in the way of animation. Meanwhile, according to configuration requirements and order of operators, Kingview will make Robots run by designed action and produce forms of the on- site data. This system is good at automatically controlling and managing of Robots.**

***Keywords*— *robots; S7-200PLC; kingview***

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## 1 Introduction

There are many factors, such as high temperature, corrosion, and kinds of radiance, which human beings suffer from and also increase labor strength of operators and even endanger their lives during the industrial production. The invention of Robots makes kinds of difficulties solved. Robots controlling system mentioned in this paper is taken THFJX-1 as Robots physical education model. The Robots is controlled by S7-200 PLC

Host computer monitoring system design is taken Kingview as configuration software. Kingview, developed by Wellincontrol Technology Development Co.,Ltd, which provides complete strategy and development platform for practical engineering problems. It can do on-site data gathering, real-time and aforetime data processing, alarm and security mechanism, flow control, animation display, output of curve and forms and industrial control network system. After the analysis of this monitoring system, two advantages have been found. First, image editing can be made best use in Kingview to shape monitoring picture and can show the running state of Robots in the way of animation. Second, Kingview can create real-time form, aforetime form and save them to designated files as well as search for appointed variables.

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## 2 Operational principles of robots controlling system

The principal part of THFJX-1 Robots physical education model includes seven sections: bottom board, experiment table (structure of shaped material), rotating bedrock, pneumatic sections, fingers, 3-D （X、Y、Z） running machine and electrical control. Pneumatic sections include magnetic valve and cylinder. 3-D （X 、Y 、Z ） running machine is a modular structure combined with driving of ball screw and gears, using to position.

Electrical control includes small scaled S7-200 PLC, power supply module of stepper motor drive, switching power supply, photoelectric sensor and so on. Sensor acquires signals, and PLC programs and control switch，position and temporal logic on stepper motor, direct current motor and magnetic valve, in order to make Robots take, move and put things within working field

Demands for control in details are:

1) Push power button, Robots is ready to work.

2) Push resetting button, resetting light is on, and Robots is return to the original position, no matter what the position it was.

3) Push start button, start light is on. Push running button, Robots extend →move down →hold → move up →return →move left →extend →move down→ release→ move up→ return→ move right, make a cyclic movement, and finally return to the original position waiting for the next start.

## 3 Allocation of input and output port

Control of Robots is completely switch control, with a fewer I/O point, and totally 9 inputs and 9 outputs. Meanwhile, to make sure the extend of the system in the future, this system is adopted highly cost performance module CPU226CN of S7-200, which has 40 I/O point, including 24 inputs points and 16

output points. The allocating of I/O is shown in Table 1.

**Tab.1** I/O allocation table of PLC

| | | | | | |
|---|---|---|---|---|---|
| **INPUT** | Positive spacing of X-axis | I0.0 | **OUTPUT** | X-axis impulsion | Q0.0 |
| | Positive spacing of Y-axis | I0.1 | | Y-axis impulsion | Q0.1 |
| | Opposite spacing of X-axis | I0.2 | | Direction of X-axis | Q0.2 |
| | Opposite spacing of Y-axis | I0.3 | | Direction of Y-axis | Q0.3 |
| | Rotating impulsion | I0.4 | | Hand positive rotating | Q0.4 |
| | Hand positive rotating placing | I0.5 | | Hand opposiiter | Q0.5 |
| | Hand opposite rotating placing | I0.6 | | Positive rotating of base plate | Q0.6 |
| | Positive spacing of base plate | I0.7 | | Opposite rotating of base plate | Q0.7 |
| | Opposite spacing of base plate | I1.0 | | Movement of magnetic valve | Q1.0 |

## 4 Design of system configuration and realization of function

By making use of Kingview, configuration design of Robots control system is given as follows:

### *A. Connect device*

Open Kingview, enter project organizer, then set up a new project, and choose its storage path and name it ‘Robots’. After entering project browser, connect device first. Host computer’s COM1 and PLC are linked by PC/PPI programming cable. Choose ‘Device/COM1’ on the left side of project browser, and double click ‘NEW’ icon on the right side of project browser, run ‘device allocation guide ’. The allocation is shown in Fig.1.

### *B. Set parameter for communication device*

In the project catalog of browser, click serial port where PLC and host computer is connected under ‘device’ to set parameters. Communication parameter of PLC is matched with that of Kingview. Meanwhile, the setting of COM1 port of Kingview is consistent with PLC, which is taken acquiescent communication parameter [1] as follows: baud rate is 9600bps, with communication protocol PPI, and mode11bit.

### *C. Build data base*

Data base is the key section of Kingview. Variables built in the data base take charge of exchanging data with outside devices and storage of relevant data. Variables connect different sections of the project within configuration into a whole [2]. Choose ‘data base/ data dictionary’ on the leftside of project browser, then double-click ‘NEW’ icon on the right side of the project browser, and the dialog box of ‘attribute of variables’ is shown up. After that, build variable data of Robots control system. These variables are consistent with PLC inner variables one by one. The input and output of PLC are totally replaced by inner variables of Kingview. By building animation connection, the practical input and output states of PLC are shown on the configuration monitoring interface in the form of animation. The definition of variables is in Fig. 2.

### *D. Design of monitoring interface and animation connection*

Enter the development system of Kingview. Set up a new window. Build sketch map of Robots control in the window. In the figure, there are Robots, start/ resetting button and lights of position of Robots. Moreover, real-time form and designated-searching form are added. Users can insert the needed variables in the form and store and search conveniently. The main map is as Fig.3.


**Fig. 1** Device allocation guide

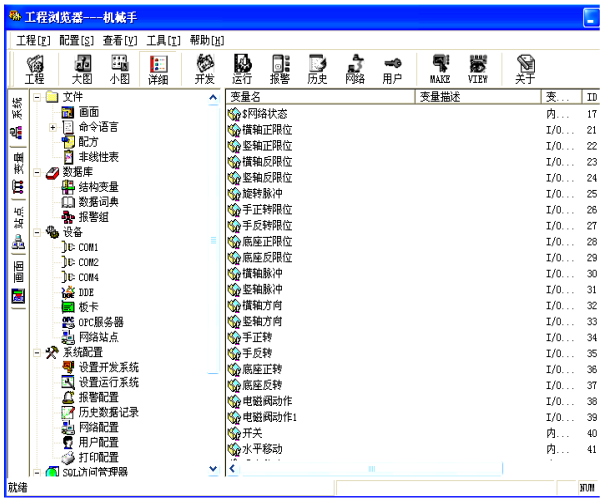


**Fig. 2** Definition of variables

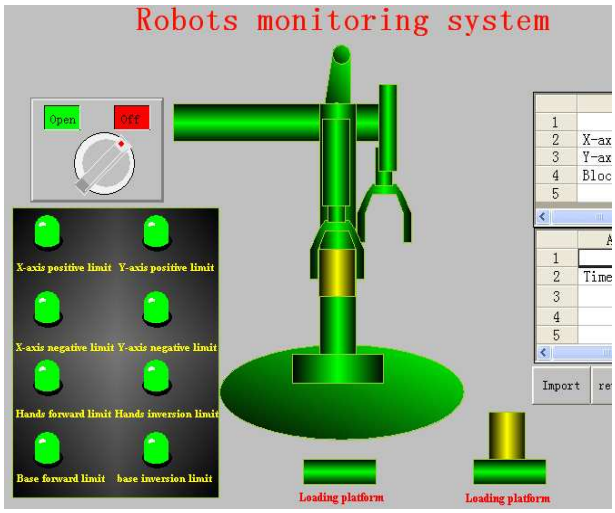


**Fig. 3** Monitoring interface of Robots

Build the relationship between the variables in data base and the objects in configuration picture, so pictures can form the effect of animation with regard to changes of practical data. Write applicable program, and users drive the program by command language. Part of the command language of applicable program is below:

If (\\ local\on-off==1&&\\ Local\opposite spacing of X-axis ==1

&&\\ Local\ Opposite spacing of Y-axis ==1)

\\ Local\ Move Horizontally =\\ Local\ Move Horizontally +1; If (\\ Local\ Move Horizontally >=100)

\\ This direction \ Move Horizontally =100;

If (\\ Local\ Move Horizontally ==100&&\\ Local\ Hand positive rotating placing ==1&&\\ Local\ Hand negative rotating placing

==1)

\\ Local\Move vertically=\\Local\Move vertically+1; If ( \\ Local\Move vertically>=100)

\\ Local\Move vertically=100;

if(\\ Local\ Hand positive rotating placing ==0&&\\ Local\ Hand negative rotating placing ==0)

{

\\ Local\Move vertically=\\Local\Move vertically-1;

\\ Local\ Block moves vertically=\\Local\ Block moves vertically

+1;

}

*E. Be System running*

According to the requirement, connect host computer, PLC and Robots. Open RUNTIME, and run Robots control system. Put PLC Switch to RUN state, then watch configuration picture is whether or not consistent with the run of Robots. If not, check whether animation cryptic connection of configuration map is good until the animation runs well.

## 5 Facing problems during design and solutions

During the process of configuration supervision, PLC and computers are communication [3] through RS232 serial port. In the experiment room, PLC and STEP-7 are communication through RS232 serial port, too. However, at certain time, there is only one device that can use RS232 serial port. So after PLC ladder diagram has been edited and downloaded in PLC, the communication between STEP-7 and PLC should be cut. Otherwise, configuration monitoring software can not sample and supervise the state of each register.

During the design of monitoring interface, it is easy to make Robots move up and down. But the rotation of base plate needs to take the variation of angles of view into account. So multiple groups of X-axis arms are needed, and build cryptic connection. When the condition is matched, counterpart images will show up. The control program is as follows:

If (\\ Local\Move horizontally==100&&\\ Local\Move vertically==0&&\\ Local\Block moves vertically==100)

{

\\ Local\Implied symbol=1;

\\ This station\Block implied symbol=1;

}

If (\\ Local\Declining button==1)

{\\ local\Move vertically1=\\ Local\Move vertically 1+1;

\\ Local\Block moves vertically 2=\\ Local\Block moves vertically

2+1;}

If (\\ Local\Declining button==0&&\\ Local\Block moves vertically2==100)

( Continued on P.49 )

$$u(k) = k_p * error(k) + k_i * \sum_{j=0}^{k} error(j) * T + k_d * \frac{error(k) - error(k-1)}{T} \quad (2)$$

In the equation (2), $T$ is sample period, $error(k), error(k-1)$ are respectively the deviation at the time of $k$ and $k-1$[6].

The integral term makes system overshoot. Because of the system is a very unstable system, the angle and displacement are must in a certain range, or it will have the phenomenon of 'knock off wall'. So $k_i$ equals to zero. The PID control result is shown in the Fig. 8.

From the figure, it is known that using the PID control can make the system to balance state in short time. And it proves that the virtual system is correct. Because the control is very rapid, we can set time scaling factor that change the system running period to watch on the cartoon interface.

## 5 Conclusion

The design scheme of software and hardware co-design is used to make the virtual system that is designed more practical. The virtual system can simulate the movement and force of the real inverted pendulum. The design with low cost is convenient and can be used in experiments and industrial scene.

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( From P.45)

\\ Local\ Move vertically 1=\\ Local\Move vertically 1-1;
If (\\ Local\Move vertically 1==0&&\\ Local\Block moves vertically2==100)
\\ Local\Implied symbol =0

## 6 Conclusion

The character of this automatic control system of Robots is that its control of physical object layer is taken small scaled S7-200 PLC, which is more flexible, accurate, easy to mend and extend. Host computer monitoring software is taken Kingview to develop configuration software, which is user friendly interface, high automation and reliable monitor[4].Furthermore, the development of this Robots control system is meaningful to the transportation of industrial on-site cargoes.

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