Application of ForceControl in the Vehicle Gasohol Delivery System

Dong LI [1]   Yanbo CHE [1]   K.W. Eric CHENG[2]

[1] School of Electrical Engineering & Automation, Tianjin University, Tianjin China.
E-mail: ybche@tju.edu.cn
[2] Department of Electrical Engineering, The Hong Kong Polytechnic University, Hong Kong,
E-mail: eeecheng@polyu.edu.hk

Abstract –This paper mainly introduces the application of Sunway ForceControl configuration software in the vehicle gasohol delivery system, and explains the hardware system structure and software implement. The system regards Sunway ForceControl configuration software as the development tools for host computer software. The vehicle gasohol delivery system can be monitored and controlled by host computer by using special I/O driver program, and setting hardware, database, drawing configuration. This system's application can reduce operating people's work intensity, carry out gasohol delivery auto-control, and improve the system's precision and stability.

Keywords - Vehicle Gasohol Delivery System, Configuration Software, Force Control, Database, RS485

I. THE FUNCTION OF CONFIGURATION SOFTWARE AND THE CHARACTERISTIC OF FORCECONTROL

With the development of computer technology, various enterprises use the computer control technology more and more widely. The new industrial automatic control system which is made up of the standard industry computer software and hardware platform is replacing traditional closed system. There are many distinct advantages such as the compatibility, opening, expansibility, economy, short development cycle and so on. Usually such system can be divided into the control, the monitoring and the management three hierarchical structures. Connecting the control hierarchy down and management hierarchy up, the monitoring hierarchy does not only real-time monitor and control, but also often completes upload, download and configuration as an influential role in the automatic control system. The hardware of monitoring hierarchy is mainly based on the industrial microcomputer or workstation, tending to the industrial microcomputer at present.

The configuration software is an indispensable tool in the industrial control system. The configuration software is defined as special software which gathers data and controls process in the monitoring hierarchy. It is a software platform and a development tool which can provide a good user interface and is easy to use by the diverse configuration ways (not program way). It pre-sets many kinds of software module which can complete the function of monitoring hierarchy very easily and support different computer hardware factories and I/O equipments. It is connected with the reliable industrial control computers and network system. It can provide all software and hardware interfaces for the control hierarchy and the management hierarchy to carry out the system integration.

The characteristic of Forcecontrol software is:
(1) Script is the C language which is easy to use.
(2) Completed equipment drivers to adapt each kind of equipment.
(3) Drawing interface is visualized completely, rich drawing storage; insert picture and cartoon.
(4) Real-time database, connect with relational database
(5) ACTIVE, the third party programming tool (VC++, VB etc).
(6) Data alarm system.
(7) Formidable report forms function.

II. SYSTEM SUMMARIZATION.

A vehicle gasohol delivery system's monitoring and measurement were managed artificially. Therefore, the delivery monitoring database refreshed slowly and made mistakes easily. Data could not be shared between delivery system and invoice system. It collected and analyzed data disadvantageously. By this system rebuilding, the delivery system is expanded from original four delivery positions to ten with the display of delivery control, measurement, temperature and so on. And it analyzes the data further. It can also give the unusual condition to indoor supervisors in a short time to process unusual condition in time. Finally, these data is written in the database and shared by the network. The system selects ForceControl as the configuration software and develops the specially driver program for the hardware. Beyond user's requests the ForceControl completes parameter display, warning, report forms and so on by the rich drawing configuration. It uses relational database (SQL Server) to complete the automatic measurement and inserts this information into the multi-purpose report forms of configuration screen.

III. SYSTEM DESIGN

There is a control room and ten vehicle gasohol delivery controllers which are concentrated in a place. The vehicle gasohol delivery area is near the control room. The system does not request web publishing. The parameters of temperature, speed, volume and breakdown and so on are gathered by special sensors and uploaded to the controller, then to the host computer by 485 bus. So the data can be inserted to real-time database. The system monitors and processes the variety of data by the configuration software. The measuring system will be shown in report form drawings to integrate the monitoring and the measurement.

1. Hardware design
The data of delivery area is gathered and transmitted by sensors. Controllers are installed with thermometer, flow

meter and electro-hydraulic valve which controls flow speed. The controller collects data from sensors to carry out gathering delivery parameters from bottom equipments. In each delivery position, the controller is connected by RS485 bus. And the RS485 bus is connected with the RS485 interface of industrial control computer to upload delivery parameters in the entire area. The equipments topology is shown in Fig. 1.

2. Software design

The delivery system is composed of user, real-time monitoring, system set and help in the menu form. The part of user includes the user management, logging on and out etc. The real-time monitoring part includes the drawing of vehicle gasohol delivery, breakdown and warning log. The system set is made up of parameters set and equipment initialization. There is a detailed system operation explanation in the help part.
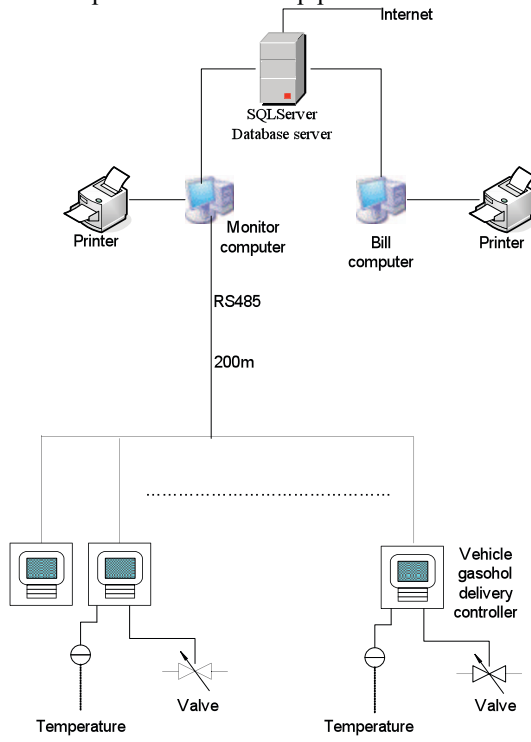

Fig. 1: Control system hardware topology

IV. SOFTWARE IMPLEMENT

A. Data processing flow
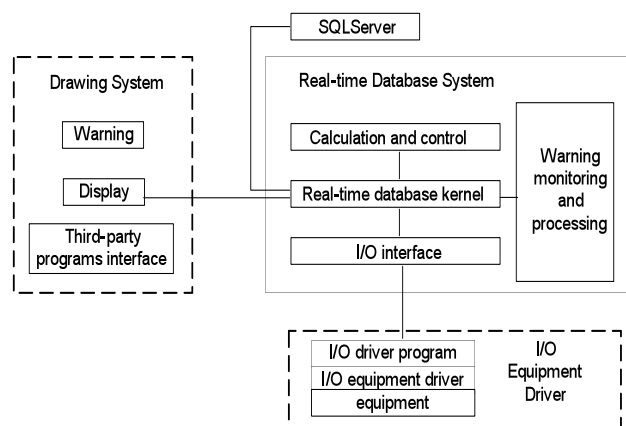
Data processing flow is shown in Fig.2.

Fig. 2: Data processing flow

2. Software flow

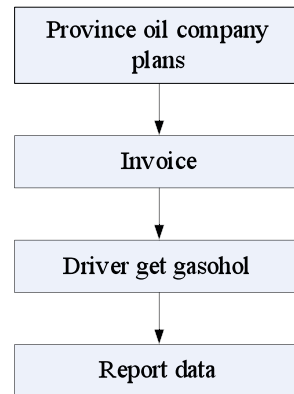Main flow of software is shown in Fig.3.

Fig. 3: Main flow of software

3. Software implement

1) I/O equipment configuration

In ForceControl, I/O equipment configuration can establish corresponding equipments and complete communication setting. There is special driver program which is developed by ForceControl, for purchasing complete set of equipment. There are ten delivery controllers in this system. It must set ten delivery controllers configuration respectively: choose serial port, set port number and set port address. (Fig. 4)

Name	Description	Redundance	Type
⇒102	Controller102	No	Intelligent module
⇒201	Controller201	No	Intelligent module
⇒202	Controller202	No	Intelligent module
⇒301	Controller301	No	Intelligent module
⇒302	Controller302	No	Intelligent module
⇒401	Controller401	No	Intelligent module
⇒402	Controller402	No	Intelligent module
⇒501	Controller501	No	Intelligent module
⇒502	Controller502	No	Intelligent module

Fig. 4: I/O equipment configuration

2) Database configuration

Database configuration makes equipments' I/O data connect with variables in ForceControl. Therefore, the database variables are set up. Controlling database variables is similar to controlling equipments to carry out various functions. (Fig. 5)

3）Interface development

• Delivery monitoring drawing

There 11 delivery positions (four gasoline, six diesel oil, one kerosene). The position information includes number, status, oil name, chemical additive, temperature, unit, pre-volume, rail-volume, spill, grounding, pump, flow meter, electro-hydraulic valve, delivery position, gasohol truck. (Fig. 6)

• Controller parameter set drawing

The process of delivery is complex and highly accurate (the error less 2 ‰). Therefore, controller must be set completely to carry out the speed and precision. Need to set these parameters: oil name, density, synchronize coefficient, temperature coefficient, harmonic proportion, chemical additive, closure parameter, stop control, overswing, and machine state. (Fig. 7)

•Breakdown drawing

The breakdown display is very important for the auto-control system. The drawing must be simple and brief as possible to make the operators clear. Therefore, each channel has alarm points independently. When the system is in the normal state, it is green. Otherwise, it is red with sound warning until the trouble is not dealt. If a serious problem takes place (for example spill), it will pop-up a dialog box to carry out the warning. (Fig. 8)

• Event and warning record drawing

To make convenience for the system failure detection and exclusion, ForceControl provides the event log module. It can monitor and record the movement of I/O equipment, real-time database, process management, network service, development system and so on and provide the inquiry function. In the warning log aspect, it also provides special module which does not only include the warning log and inquiry, but also has the function of warning confirmation to find and deal warning in time.

4) Backstage programs

• Download oil bill

Reading database delivery parameters depends on the windows remote data source. This subprogram is placed in the application procedure movement. The part of entrance program opens the database. In the program cycle (scanning period 1000ms), it waits delivery requisition and download oil bill. (Fig. 9)

• Delivery monitoring

The delivery monitoring includes the delivery position state, real-time temperature, real-delivery volume, pre-delivery volume, unit, spill, grounding warning and so on. This part runs in the script of monitoring drawing. The entrance window movement is to find oil name correspondingly in the database. In window movement cycle, the program carries out renewing delivery state, unit and volume in real-time.

• Parameter log

When the delivery finishes, the actual data is written in the database to inquire in the future and to report form. The principal question is how to know the conclusion of delivery process, in other words, to get a rising edge.

|	Name	Description	I/O link
1	tiyoutime101	Time	DESC=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|time
2	tidanhao101	Number	PV=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|number
3	tidan101	Bill	DESC=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|bill
4	yingfadanwei101	Unit	DESC=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|unit
5	yingfaliang101	Volume	PV=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|volume
6	tongliang101	Barrel volume	PV=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|barrel volume
7	yibiaoxishu101	Meter coefficient	PV=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|meter coefficient
8	youmidu101	Density	PV=Oil delivery: Line|1 Function|read-write parameter Command|8 Set parameter parameter|density

Fig. 5: Database configuration

Ready status　　　　　Run status
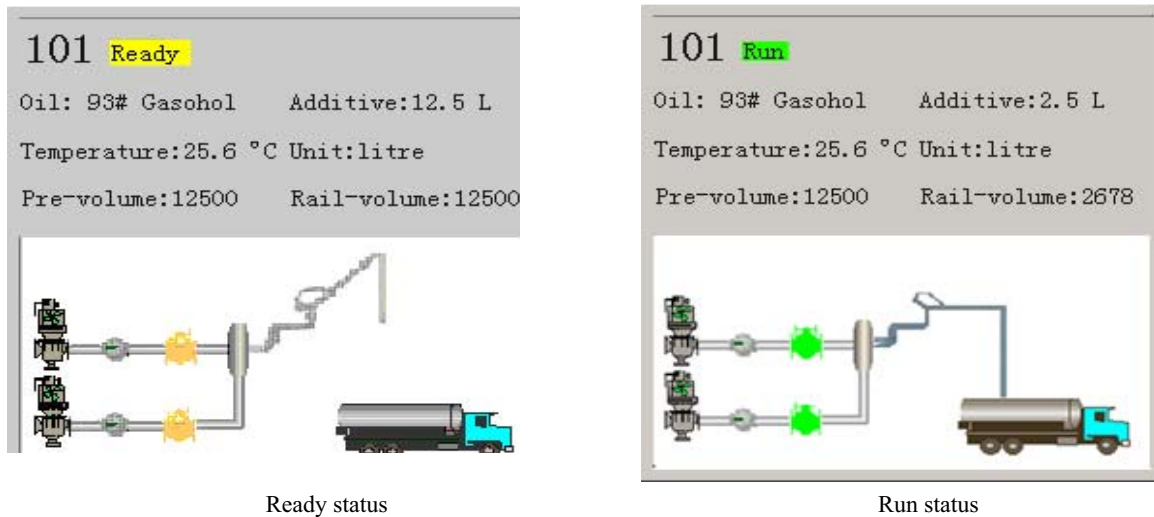
Fig. 6: Monitor display

Position	Name	Density	Synchronize coefficient	Temperature coefficient	Proportion gas:ethanol	Additive	Closure parameter	Stop control	Overswing
101					:				
102					:				

Fig. 7: Delivery control

Fig. 8: Breakdown drawing

Fig. 9: Download oil bill flow

coordination between software and hardware. The ForceControl achieves this goal very well. By this transformation, it meets the anticipated result in computer monitoring and machine movement. The system is more reliable. It improves operators' working conditions and reduces the adverse effect which human factors bring.
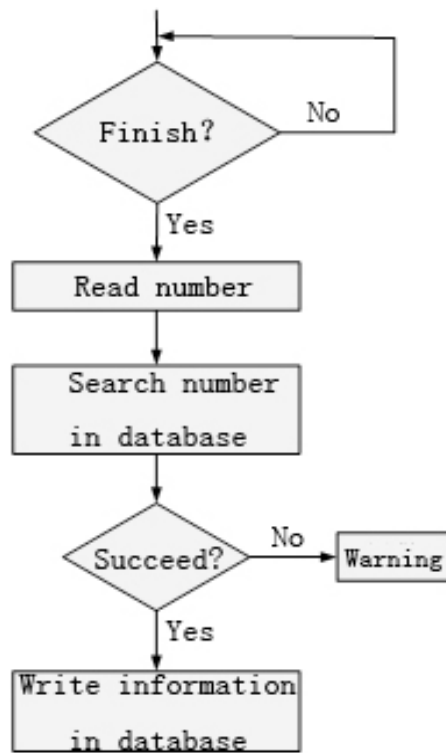

Fig. 10: Delivery parameters log flow

The program monitors the finish in cycle. Once the delivery completes, the position information will be written in the database. It includes the real volume, finish time, normal or not (error less than 2 ‰). Its flow is shown in Fig. 10.

V. CONCLUSION.

The delivery process is very complex. To reduce the delivery error in the permission scope, it needs the

REFERENCES

[1] Beijing Sanway ForceControl Technology Co., Ltd. Graphical Interface and Development System. Beijing 2007
[2] Li Meng, Xu Tao, Feng Jie. Application of Forcecontrol in Supervisory Control System of Tank Area of lubricating oil Great Wall, Control Engineering of China, 2007, (14), pp.25-26
[3] Cai Wei, Liu Bo. Application of Forcecontrol Configuration Software in Automation Supervisory Control, Journal of Heilongjiang Hydraulic Engineering College, (33), 2006, pp.108-110
[4] Ma Guohua. The Configuration Software and Application, Beijing: Tsinghua University press, 2001
[5] Tan Haoqiang. C Programming Second Edition, Beijing: Tsinghua University press, 1999