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Analysis for Information Integration Platform on Warship

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Abstract

On the *basis of network establishment, system architecture of warship's information integral platform and XML distributed data exchange were researched. To focus on information system data and network resource on warship, the multilevel software architecture was adopted in simulation. On the data layer, circulated simulation data about manoeuvring, ship system, power and navigation were got. On the service layer, the software interface of all the simulated systems was supplied, which realized data collection and information storage. The last layer was for user by which human-computer interface was got through client software. To improve stability of ship's local area network, double-ring topology was used as the main network, and very popular software named Wonderware in field of industry control was developed. With IAS platform, deployment of all the sub-stations was completed, and links between each collection and database were established. Multilevel computer network and information data integration frame on warship had many purpose, such as serving for oriented application system, data communication, information share and so on.*

Keywords*: Information Integration; System Architecture; Middleware; Double Ring Topology; XML*

1. Introduction

With the rapid development of information technology, the information integrated automation system are to ship. Marine platform information integration system can carry on the unification to the vessels of the subsystems of the internal information management, realize the information sharing and exchange, eliminate the information in the shipping system, is to reduce ship in operation and maintenance costs, improve Marine economic affordability of effective technical support. Marine platform information integration system in the ship automation control and management subsystems, digital, network elements, on the basis of communication network, command and control as the core, focusing on information and computer as the tool, in various circumstances, comprehensive optimization of ship control and management as the goal, to reduce the operation and maintenance cost for the purpose of comprehensive network platform.At home and abroad of Marine platform information integration system in the distributed processing technology, network security technology, communications, electronic control system hardware and software development and network reliability redundancy design aspects have carried out extensive research, the data acquisition, processing, transmission, protection, storage and backup, *etc* have been able to apply. But the research on heterogeneous data integration, the dynamic definition and the automatic transfer of information flow, centralized control of information such as lack of in-depth research, accordingly In this article will focus on research the problem above. By mastering the key technology and design method of speeding up the information

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construction of a ship, meet the needs of our country shipping and national defense construction.

2. Information Integration Platform Design

2.1. Hierarchical Information Integration Platform System Structure Research of the Ship

Marine platform for data exchange and information integration system business platform of the system operation, it standardizes the information exchange and system operation standard and interface definition, for the business application system provide a good interface, stable running environment and strict management interface. Marine information system structure as shown in Figure 1, the processor, smart sensors and device with digital interface physically distributed in all parts of the ship, operated independently, they equipment through the network connection, constitute a distributed system. The system is connected by integrated support environment will separate system integration for information exchange and messaging, form an organic whole. Marine platform information integration system is responsible for in addition to the charge system and all other information sharing and exchange.Resource management center, control center, information management and information transmission between the console and unified messaging through the control system of platform information integration system complete [1].

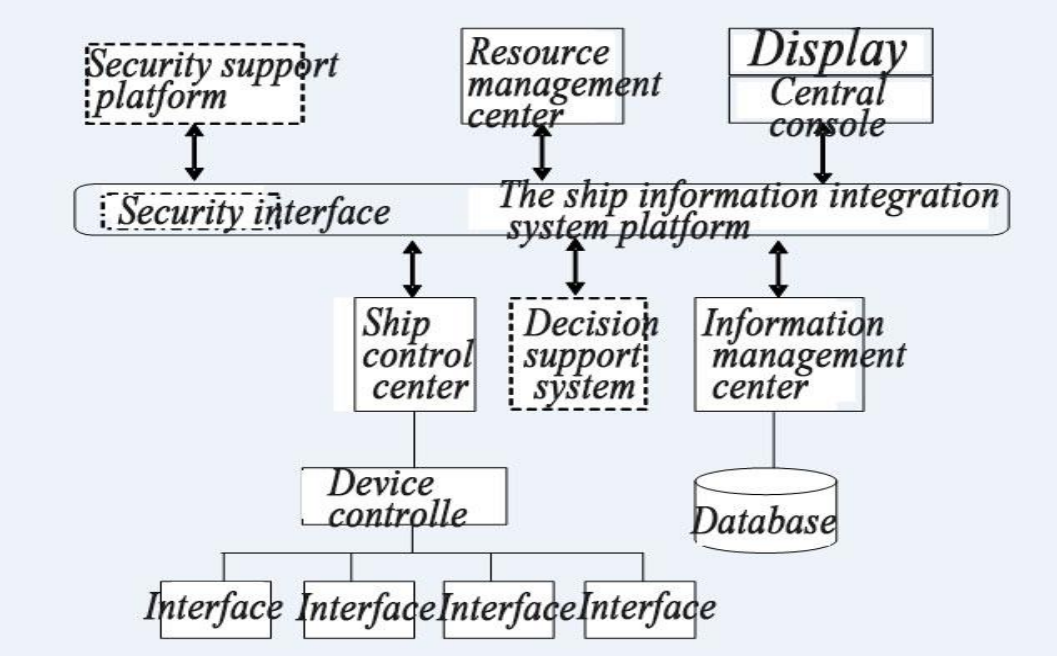

Figure 1. The Structure of Shipping Information System

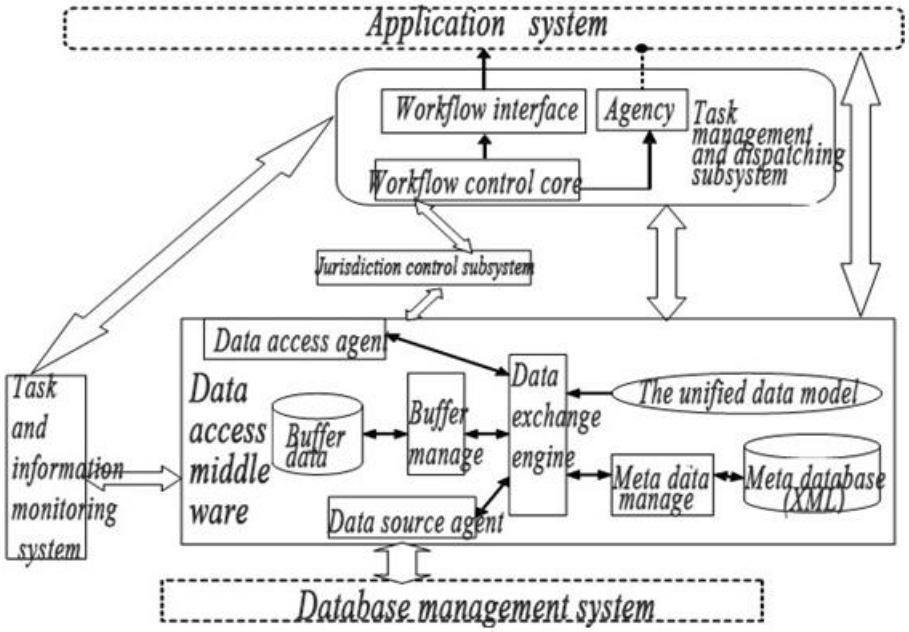

Figure 2. The Architecture of Integrated Information System

Marine platform is the core of the information integration system task management scheduling subsystem and data access middleware of two parts, the platform itself is as the middleware in the form of common component to support the application requirements of function, including process scheduling and control, access control and data access and other support. The bottom of the system is of all kinds of distributed heterogeneous database management system. Marine platform of information integration system architecture is shown in Figure 2, task management scheduling subsystem by passing message control of the process of application in the system module, data access middleware to send and receive data through data process control applications.Access control subsystem, task and information monitoring subsystems through the monitoring and control of the data flow and control flow to complete its function [2-7].

2.2. The Application of XML in the Distributed Data Exchange Technology

XML is a kind of meta markup language, can provide description of structured data format, which provides a method independent of running programs to share data, is used to describe information automatically a new standard language. XML is composed of certain rules, these rules can be used to create the markup language, and can use a simple program called analysis program to handle all the newly created markup language, XML created a anyone can be read and written language and program. XML can increase the structure and semantic information, can make the computer and server real-time processing various kinds of information. XML with its extensibility, the advantages of structural and platform independence makes it rapidly distributed data exchange standard, distributed data exchange based on XML is not only become a research hotspot now, has become today's data exchange an ideal solution.

In XML tags are not predefined, users must be predefined need to use the tags, XML is a language can be self-describing. XML DTD (Document Type Definition) to regulate these data, the XSL (eXtensible Stylesheet Language) is a kind of to describe the mechanism of how to display the Document, it is a description Language of XML style sheets.XSL includes two parts: one is used to transform the XML method; A method for formatting XML documents.By using XML, not only can deal with text and graphics, but also can deal with the document type definition of multilevel and interdependent system,

the data tree, the source data, hyperlink structure and style sheets. These characteristics, making the distributed data based on XML and database access middleware can shield the underlying network data transmission between heterogeneity, let the upper transparent data exchange. For the description of the data source and the global template, can use XML DTD or XML Schema concepts. For each subsystem data schema standards in data source. According to the data format of the subsystems of the standard, make the information platform of the global template, which formulate the corresponding mapping rules. The global Schema of a data item several subsystem Schema corresponding data items. Other data formats are all custom XML documents. For a global view to the view of each data source mapping mode, using the GAV way, namely by the data source view to generate a global view. The data access middleware including user access interface, model definition and management module.

(1) DTD and XML Schema

XML provides a mechanism called a document type declaration, is used to define the constraints of logical structure, support the use of predefined storage unit.Document type declaration specifies the document using the DTD. Preface part of the document type declaration appear in the document, after and before the first element in the XML statement.It can include a DTD, also can identify the DTD document's URL. So the W3C introduced the XML Schema specification. In fact, XML Schema is also a kind of application, it is will use a DTD to XML language specification to define. Compared with a DTD, XML Schema has the following several advantages: consistency, scalability, ease of use, the standardization and interchangeability.

(2) DOM and SAX

In order to make the XML application development can be independent of the XML parser, W3C and XML_DEV mailing list members respectively puts forward the two standard application interface: DOM and SAX. In the application, the XML parser based on DOM transform an XML document into an object model to a collection of application is through the operation of the object model, to implement the operation of XML document data. Through the DOM interface, applications can access at any time any part of the data in an XML document. As a result, this interface provides a hierarchical object model to access the XML document information way, the hierarchical object model based on XML document structure formed a node tree.Since XML is essentially a kind of hierarchical structure, so the description method is quite effective. SAX provides access mode is a sequential pattern, it is a way of fast reading and writing XML data.When you use the SAX parser to analyze the XML document, will trigger a series of events, and activate the corresponding event handler, the application by the event handler for the XML document access, thus the SAX interface is also known as event-driven interface.

2.3. Simulation Platform of Information Integration System Analysis and Design

2.3.1. System Configuration: The simulation platform of information integration system is mainly composed of ships, power, four functions such as navigation subsystem. The system structure design is shown in Figure 3. System is divided into user layer, service layer and data layer.

(1) User Application

User layer directly to operating personnel. It through the client software provides the human computer interaction interface, four system respectively according to the important information system.The user layer includes a operating console ECC1, a ship system console ECC2, a power system console ECC3, a integrated navigation system console ECC4.

(2) Service layer

Service layer mainly provide ship's monitoring information, mainly includes two double machine hot backup application server.IAS software application server deployment.

(3) Data Tier

Data layer console operation instructions, the condition of analog sensor, return instruction execution.Data layer includes 1 simulation equipment and its corresponding software including IOServer, simulator software and control model.At the same time, the data layer includes one database server, provide real-time and historical data management, through the deployment is essentially and INSQL software implementation, description as shown below.

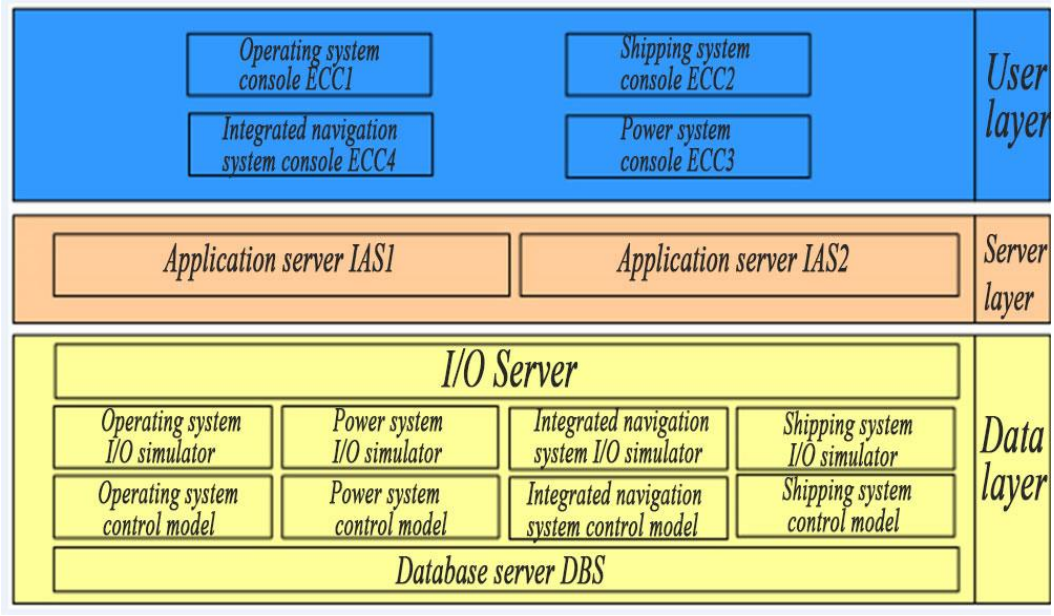

Figure 3. Information Integration Simulation System Structure

2.3.2. System Hardware Design: 1. Network System

In order to achieve the design requirements, the use of industrial Ethernet and switch build double ring type fiber optic backbone, with 100/1000 m Ethernet interface. A and B double loop network with A net each containing one layer 3 switches and two layer 2 switches, A and B network via gigabit fiber optic cable connected between the layer 3 switches, the network of correlates with cable connected between layer 2 switches. When optical fiber loop failure occurs, can guarantee in 300 ms time scale network self-healing, each subsystem of real-time data is not lost [8-11].

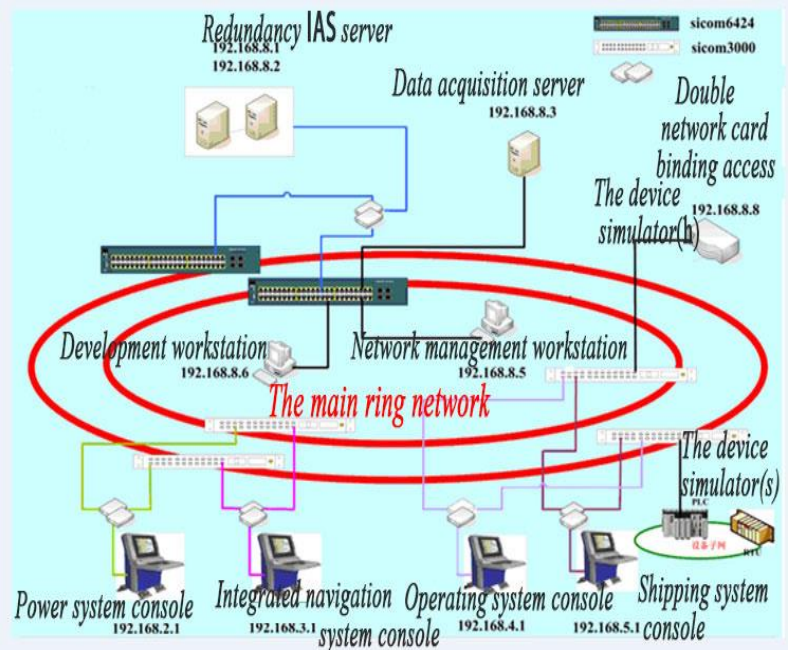

Figure 4. Double Ring Backbone Network Access Structure Diagram

Simulation system of control, ships, power, navigation, and so on four important subsystem used their engineering console host 2 road gigabit Ethernet interface to access to the main ring double link way A, B network access switches gigabit/MB electricity, realizing the mutual communication and integration between subsystems, at the same time guarantee the reliability of the subsystem of business.Information signs for general system, using the number 1 gigabit Ethernet interface any access to A network or B in A single link network correlates of gigabit/electricity, server and equipment simulator also through two-way gigabit Ethernet interface in double link way connected to the backbone.

In order to ensure access to the backbone of the subsystems to maintain independent on the function, manageable again at the same time, could be divided into different VLAN backbone, each subsystem respectively in different VLAN, by routing to realize interconnection between different VLAN, we can be the backbone of the equipment IP unified planning. Double ring type backbone access structure as shown in Figure 4.

Backbone of the double card access by developing double card binding program implementation. Binding procedures for host the double card system for binding, binding subsystem after foreign only provides a virtual IP address, business data what specific use the link in the process of running by binding program is responsible for the maintenance. Under normal circumstances, the binder selected a main link is used, and regularly sent to link state detection package (state package). When the rapid growth of network traffic, procedures to enable load balancing using double ring network provides aggregate bandwidth in order to improve the hosts on the network performance, when the primary link fails, will host the redundant links automatically switch to the data transmission.

2 Service System

Service system choice Factory Suite A2 with IAS products as the core industry suite, including the IAS, Intouch, INSQL, Active Factory, Suite voyager, *etc*. Server (workstation) is a simulation system provides a set of core services, including data model, business rules, control logic of the management and maintenance, several server types that exist in the system can be described as follows:

(1) The IAS server

IAS server for providing data services to engineering console man-machine interactive terminal, is the core of the system to the server Considering the important role of IAS

server, we adopt double redundancy mode of AOS application level backup server. Will be deployed in the main AE data model of the engine respectively for two IAS server, the server through the network card connected directly, using the redundant message channel (RMC) on the heartbeat messages sent to implement state detection, once the primary server fails, the primary engine of AE services will switch to the standby server AE_Bck engine, implement application service switching between two servers. At the same time, in the main in the case of two servers installed two sets of InSQL database, will need to store the history data respectively in the two InSQL database. When a server fails, another server InSQL database provides data services, the historical data is stored on the standby server InSQL, after recovery, the data on the standby server to migrate to the master server.

(2) Data acquisition server

Data collection server provides access to the underlying device simulator ability, logical I/O driver module corresponding system structure in application layer.

(3) OPC server and DB server

OPC server and DB server to provide data source for equipment simulator, a logical part of the system structure of corresponding device simulator module.

(4) As the backbone of the backbone management workstation

Backbone workstation management maintenance services, workstation run backbone dedicated network management software.

(5) The development workstation

Development workstation for system development, debugging and maintenance service, workstation run Wonderware integrated development environment.

The Design of System Software: Different from the traditional system, under the integrated architecture of software system can adopt the way of "building blocks" for application development, the realization of the convenient and fast communication between applications and upgrades, to eliminate using proprietary software, hardware, interface and connection limit. Adopt integration system structure of software system has the scalability, portability, interoperability, adaptability, easy access, high availability and high anti-destroying ability. Integrated software system by the operating system layer, middleware layer, infrastructure services layer and application layer. The middleware and infrastructure services layer is the core part of the integrated software system, the middleware layer between operating system and application of real-time communication and resource sharing;Infrastructure services layer to application layer provides the application of management and information exchange, and other basic services.In fact, it is because of the existence of the middleware and infrastructure services layer, determines the integration software system is different from traditional software system. Simulation is based on the integration of the software system design, within the scope of the whole ship development and implementation of a unified system software and application software architecture, each subsystem based on object oriented Wonderware system platform and ODBC, DCOM (OPC) and other middleware encapsulation into system software component (application software). Isolated application software and the underlying system software platform, the subsystem of relative system platform have the ability to plug and play. At the same time, the integration of the software system has a very high interoperability between each subsystem, broke the each subsystem of exclusive proprietary software and hardware resources (*i.e.*, "chimney" structure), improves the adaptability of Marine platform, the system overall performance has greatly enhanced, theoretically has infinite extensible ability.

1. Software Components

Simulation software mainly consists of two parts, software and application software development, software which belong to the open software system middleware and infrastructure services category.A ny complex business subsystem of the future will be in a standard way of application software are integrated into the platform of simulation system, at the same time, any extension of the current system subsystem can be easily.

(1) The system monitoring software mainly adopts the Wonderware development environment is a mature industrial control configuration software platform monitoring software platform basic framework is divided into three layers. Below is a software interface layer, or by the I/O Server receives real-time monitoring data were collected. At the same time by IAS server will monitor the data sent to the historical data server, and using InSQL software for management;At the same time with various RACES (such as PLC, RTU) communications, a layer of control orders.Middle layer including IAS application servers and other various applications.IAS application servers using the mature commercial Wonderware InTouch HMI to provide a visual process, it provides a new level of real-time data acquisition, alarm and event management and operation of data services, and collaborative engineering ability.Display control units, the top is the standard of its ability to interact through the client software provides a powerful and rich graphics components, provides a friendly man-machine interface, real-time display platform for each system state, and can communicate with the application server display control units and send control instructions.The system USES InTouch to write the man-machine interface.Platform monitoring system of communication protocol is the communication between the language system, the simulation system of substation and the I/O servers using standardized protocol of maturity.Engineering console (client) and adopts object-oriented communication protocol between servers, support the construction of a complex system and powerful system expansion ability.

(2) The simulator based on Visual Studio 6.0 development environment use c++ language development.

(3) Application software including control system, power system and comprehensive guide system, data storage, data simulator system, *etc*.

2. Operating Mechanism

Control system, power system and the guide system interface data from IAS Server system model, the system interface control command, first of all, into the IAS, then mark point in the IAS is mapped to the corresponding I/O Server.Simulator I/O module receives the IAS interface control instructions, to find the instruction set, depending on the directive call the corresponding data simulation function for data simulation. Simulator will data simulation results back to the I/O module, by IAS again through the I/O module to obtain the corresponding data and update the corresponding tag. Interface data along with the update of IAS markers in update. The working mechanisms of the simulation system software is shown in Figure 5.

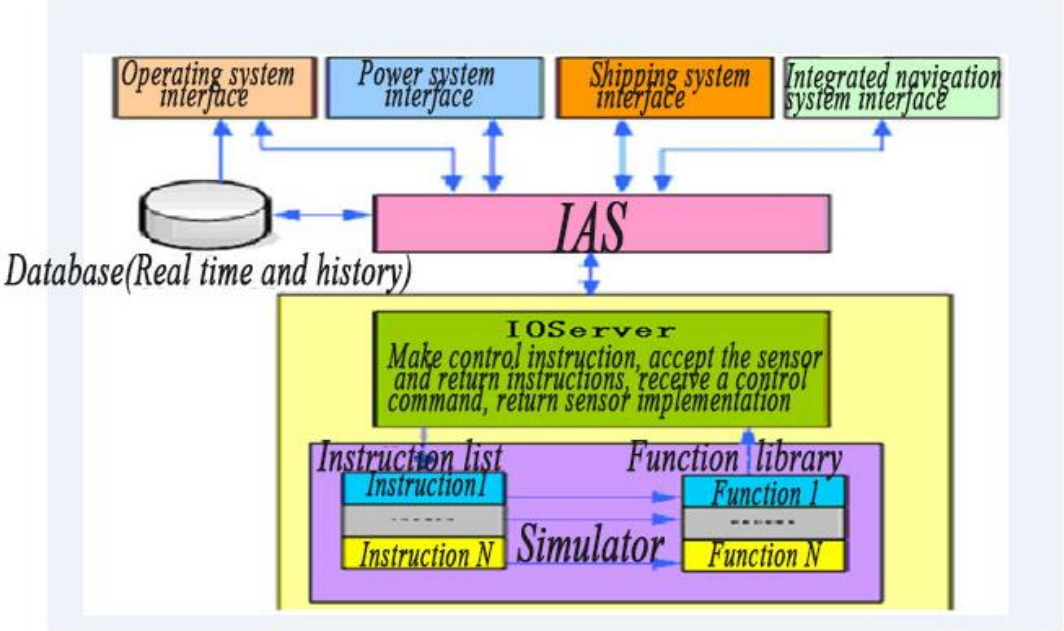

Figure 5. Simulation Software Working Mechanism Diagram

System main interface is divided into three parts, the first part mainly contains the date, name of ship, work mode, depth, heading, speed, cabin pressure, auxiliary power consumption, main engine rate of revolution, and other important parameters, is derived from the control system, power system and the important parameters of guide system.In addition, also including the subsystem of alarm and alarm list shortcuts.Part 2 mainly include simulation system of each subsystem: control system, power system and the guide system. Click the system control button to enter the corresponding monitoring interface, click the set button to enter the system key parameters Settings. Part 3 mainly includes help, information, alarm, login and system overall management functions such as navigation, click the help button, the pop-up help documentation; Click the information button, pop-up equipment main information monitoring system; Click the manage button, enter the page of system management; Click the user button, enter the system user Settings; Click the button and enter the system Settings page; Click the tools button, enter the page of system tools; Click the view button, select the system explorer view; Click on the login interface, choose user login name and password; Click on the home page, then return to the system main interface.

Conclusion

Shipping information in the direction of the future will be to build integrated architecture, the ship will implement the interconnection between heterogeneous systems, communication, implementation platform system seamless integration of the interaction between internal information sharing, to implement the necessary between heterogeneous systems, safety control each other. This will require in a unified software platform, the monitoring software of the system and other auxiliary analysis software embedded in the main body in the form of module software.In this paper, according to the design requirements of simulation system and the network architecture, to determine the simulation platform of networking and system integration solutions, finally finished the design of the simulation system work.

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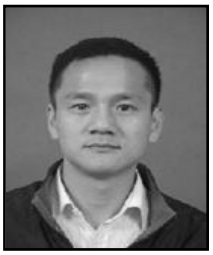

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