

# A Comprehensive Management Control System Design Method

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**Abstract**—This paper proposes a simulation system comprehensive management control software design method, which is used to monitor, manage and maintain the simulation system, and manage various hardware, software, data and information in the control system. It is management software that considers various types of management requirements. Used for node power-on, software startup, data distribution before simulation, system control, node monitoring, network management, time management, system monitoring, software shutdown after simulation, node shutdown, etc.

**Keywords**—management; control; simulation

## I. INTRODUCTION

The comprehensive management control software includes nine components: data maintenance component, software maintenance component, node management component, system control component, node monitoring component, system test component, system monitoring component, network management component, and time management component.

## II. DATA MAINTENANCE COMPONENT

It can manage various data of the system, including input, editing, storage, backup, update, distribution and so on. The initial data can be distributed uniformly before the system is run, and the update data can be distributed in real time during the operation to ensure the consistency and real-time of the data of each node of the system. After the data maintenance component distributes the data, the data receiving node needs to return a response message after receiving the data.

The data maintenance component consists of six modules, including: data input, editing, storage module, backup module, data query, retrieval module, distribution module, receiving, query, retrieval, response module, response information receiving, statistics, and prompt module.

### A. Design of Data Input, Editing and Storage Modules

The data in the database is input by human-computer interaction mode, and the human-computer interaction interface is designed for each type of database combined with the data structure of the database. The human-machine interface provides basic data management functions, including data addition, deletion, modification, query, database backup, and restore.

### B. Design of Backup Module

For all kinds of databases, use VC to call SQL statements to back up the database as a data file.

### C. Design of Data Query and Retrieval Module

The query and retrieval of the database after setting up various types of equipment (simulation equipment, management and control equipment). For all kinds of databases, use VC to call SQL statements, query and retrieve data.

### D. Design of the Distribution Module

The data maintenance component distribution module transmits by TCP.

### E. Design of Receiving, Querying, Retrieving and Answering Modules

After the listening software receives the command through UDP, it executes and records it, and then reply to the control software.

### F. Design of Response Information Receiving, Statistics, and Prompting Modules

The response information received by the data maintenance component is displayed in the message window of the software, and is recorded in the form of a data file, and the component clears the last recorded data each time it starts.

## III. SOFTWARE MAINTENANCE COMPONENT

The system can maintain the software system through the network, including: installation, upgrade, fast recovery, and so on. During system integration and use, each system does not allow the use of external interface device maintenance software, which requires unified maintenance by the server. If the modified software needs to be installed or sent to the server, it will be uniformly loaded by the server to the relevant node. After the software maintenance component issues a software maintenance command, the node that needs to be maintained needs to return a response message.

The software maintenance component consists of four modules, including: software management module, software remote installation module, software remote upgrade module, software remote quick recovery module.

#### A. *Design of Software Management Module*

The software is distributed across the comprehensive management server. It is mainly management through the manual.

#### B. *Design of Software Remote Installation Module*

The control machine remotely copies the software files, and the software to be installed is installed by the relevant personnel.

#### C. *Design of Software Remote Upgrade Module*

Recopy and install.

#### D. *Design of Software Remote Fast Recovery Module*

Recopy and install.

### IV. NODE MANAGEMENT COMPONENT

The computer can be started, deactivated, closed, restarted, and the system status is queried, and the managed node needs to return a response message.

In the process of using the system, there are two ways of node management. In addition to the unified management by the node management component of the comprehensive management, it can also be managed by the operators of each node. Regardless of the management method used, after each node preparation work is completed, it is necessary to feed back a message to the node management component, and the node management component can also query the preparation status of each node.

The node management component is composed of four modules, including: a node management object query module, a node management instruction issuing module, a managed node listening, an instruction issuing module, a response information receiving, a statistics, and a prompting module.

#### A. *Design of Node Management Object Query Module*

Open the simulation device database, the comprehensive management device database, and manage the selected computers in the database.

#### B. *Design of Node Management Instruction Release Module*

Based on the simulated node computer management database, the node management component selects several computers, clicks the node management command button, and the component sends commands in the local area network in a broadcast or unicast manner. The execution flow differs depending on the type of computer selected. The node management component is relatively simple to manage the computer directly connected to the main network, and the management and response information exchanged with the subnet machine must be transited through the interface machine, which is relatively complicated.

#### C. *Design of the Management Node Listening and Command Issuing Module*

The listening program of the managed node is set to start automatically when power-on. After starting, it judges which type the machine belongs to according to the number of computer network cards and IP settings, and sends a start response command, then starts the listening process and receives various external commands.

#### D. *Design of Response Information Receiving, Statistics, and Prompting Modules*

The response information received by the system control component is displayed in the message window of the software, and is recorded in the form of a data file, and the component clears the last recorded data each time it starts.

### V. SYSTEM CONTROL COMPONENT

It can control the system, including start, pause, continue, end, real-time operation and proportional real-time operation control. For the start, pause, resume, and end instructions, it can be executed immediately or delayed. For delay execution, the delay time  $\Delta T$  needs to be input. For proportional operation in real time, you need to enter the scale factor  $M$ .

The system control component only controls the simulation device and does not directly control the entity. After the system control component issues the system control information, the controlled node needs to return a response message. In addition to the above functions, the system control component also supports the exit and join of the simulation device in the process.

The system control component consists of six modules, including: the controlled object query module, the control command issuing module, the controlled node listening module, the system member joining the exercise module, the system member exiting the exercise module, the response information receiving, statistics, and prompting module.

#### A. *Design of the Controlled Object Query Module*

Open the simulation device database, the comprehensive management device database, and manage the selected computers in the database.

#### B. *Design of Control Instruction Release Module*

System control commands issued by the system control component are recorded as database files. The specific contents of the database file include: serial number, program name, program status, the name of the computer where the program is located, the IP address of the computer where the program is located, the path of the computer where the program is located, and notes.

#### C. *Design of the Listening Module of the Controlled Node*

The control of the node is designed by the development unit of the node. Receive, execute, record, and respond to commands such as start, pause, resume, end, delete, and join issued by the control program.

For a system in which someone is involved, when receiving a system control command, in addition to prompting the trainee in the form of display, there should be a voice prompt.

#### *D. Design of System Members Join Exercise Module*

The system members on the controlled node execute action after receiving the join exercise command.

#### *E. Design of System Member Exits Exercise Module*

The system members on the controlled node execute action after receiving the exit exercise command.

#### *F. Design of Response Information Receiving, Statistics, and Prompting Modules*

The response information received by the system control component is displayed in the message window of the software, and is recorded in the form of a data file, and the component clears the last recorded data each time when it starts.

### VI. NODE MONITORING COMPONENT

It can receive and store the simulation confrontation information released by the simulation node in real time, process the information, and realize the display, query and alarm functions of the node running status.

The node monitoring component consists of two modules, including: simulation confrontation information receiving and storage module, data anomaly detection and alarm module.

#### *A. Design of Simulation Confrontation Information Receiving and Storage Module*

The node monitoring component receives the simulation information during the simulation system running through the socket and the RTI, and the received and released information is recorded in the form of a database file. The specific contents of the database file include: time, source IP, source port, type, content, and remarks.

#### *B. Design of Data Anomaly Detection and Alarm Module*

Receive simulation confrontation information using VC programming. The same entity can not receive the entity status information for 12 seconds, and the entity is considered to have exited the training. The alarm prompts that if more than two simulation confrontation information sent by the same entity is received within 20 milliseconds, the node software is considered to have some problem and alarm.

### VII. SYSTEM TEST COMPONENT

The main function of the system test component is network performance test. The communication delay and packet loss rate of the network are tested by publishing test information.

System testing is an important auxiliary tool in system integration and system operation. For comprehensive management and control, the system monitoring component is used to test the running status of each computer in the system, and the simulation confrontation information released by the node monitoring component test system is utilized, and the

network monitoring component is used to test the internal system. The state of the network, the node management component is used to test the response of the system to the node management information, the system control component is used to test the response of the system to the system control information, and the data and software maintenance components are used to test the response of the system to data loading and software loading.

The system test component consists of two modules, including: human-computer interaction and display module, network performance test module.

#### *A. Human-computer Interaction and Display Module Design*

The human-computer interaction and display module is designed in combination with the tested object.

#### *B. Design of Network Performance Test Module*

The system test component issues a test information through the socket. The size of the test information is the same as the entity state information. Each simulation node returns the test information immediately after receiving the test information through the listening software. The system test component counts the number  $N$  of test information, calculates the difference  $\Delta T_i$  between the return time and the release time of the test information of each simulation node, and counts the communication delay of all the simulated nodes.

$$\Delta T = \frac{\sum_{i=1}^N \Delta T_i}{2 \cdot N}$$

If the number of simulated nodes in the system is  $M$ , the packet loss rate is

$$P = \frac{N}{M}$$

The test results of the system test component are recorded in the form of a database file. The specific contents of the database file include: monitoring time, computer name, computer IP address, communication delay, packet loss rate and remarks.

### VIII. SYSTEM MONITORING COMPONENT

It monitor the computer in the system and monitor the running status of the system in real time, record and analyze the running status, automatically display abnormal phenomena, abnormal parts and alarm prompts. The monitoring content is the computer CPU usage and memory usage.

The monitored computer needs to add a monitoring module to automatically send system operating status information to the system monitoring component at regular intervals through the socket.

The system monitoring component consists of three modules, including: monitoring node acquisition and release module, monitoring information receiving and storage module, data anomaly detection and alarm module.

*A. Design of Monitored Nodes Monitoring Information Acquisition and Release Module*

The control machine sends a system monitoring command through the socket mode.

*B. Design of Monitoring Information Receiving and Storage Module*

The information received by the system monitoring component is displayed in the message window of the software and recorded in the form of a database file. The specific contents of the database file include: monitoring time, computer name, computer IP address, CPU usage, memory usage, and remarks.

*C. Design of Data Anomaly Detection and Alarm Module*

The system monitoring component can analyze and display the changes of the computer CPU and memory over time, and then give an alarm prompt after an abnormality is found.

If the CPU or memory usage exceeds 90%, prompt.

#### IX. NETWORK MANAGEMENT COMPONENT

The network management component is responsible for network management monitoring, and can manage and control network resources, network traffic, network status, network device attributes, permissions, service requests, communication links, and information exchange.

The monitoring content includes the transmission speed of the network, the amount of data transmitted, and the display, query and alarm of the network running status.

The network management component is composed of four modules, including: a main interface module, an information processing module, a command generation module, and an information receiving module.

#### X. TIME MANAGEMENT COMPONENT

The astronomical time used in the system can be synchronized, and the time management component and the system control component are distributed in the same seat.

During the exercise preparation phase and during the exercise, the astronomical time of all computers in the system can be synchronized. Based on the computer with time management seat, it is controlled by people. Click once, call the API function provided by Windows to take the local clock T, and release the clock T by broadcast. All computers in the network receive T and modify the clock of the computer to T. For the interface computer in the network, the clock T is issued to the internal network connected to the interface computer, and the computer in the internal network receives the T, and then changes the clock of the computer to T.

The time management component consists of two modules, including: astronomical time acquisition and release module, and each node astronomical time listening module.

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