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Design and Implementation of Simulation Training System Based on MVC Architecture

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Abstract. With the development of technology of computer, the missile force has been developing towards informatization. A new training method based on simulation training is launched. This article mainly introduced missile simulation training system and the MVC architecture, and proposed the structure of MVC architecture design simulation training system, in the last, implementing the simulation training system for a missile weapon. The usage of MVC frame design achieved a good structure, loosely coupled and high cohesive simulation training system, which effectively improves the development and late maintenance cost of the simulation training system, and realizes that one system can meet the requirements of multiple batches of missile weapons.

1. Introduction

With the development and progress of computer technology, cloud computing, artificial intelligence, database and other technologies continue to develop in depth, and the army is also gradually moving towards the information age. The simulation training system based on computer technology can break through the objective limitations of traditional training, and is widely used in military training of all countries in the world with its unique advantages. Simulated training is an important means for troops to carry out training. Over the years, analog devices have gone through a process from simplicity in the past to shape in the present. In recent years, the new type of training equipment has been developed and manufactured synchronously with the main battle equipment, and the training equipment has been dispatched to the troops before the battle equipment. The successful implementation of distributed large-scale simulation system extends the role of simulation training platform. However, in the long run, the portability and scalability of the simulation training platform have become the focus because of the high alert status and the normal field characteristics of the army. This paper realizes the simulation training platform based on MVC architecture under network conditions. The traditional training equipment has a lot of defects, such as large volume, heavy weight and difficult to transport, while the analog training platform has the characteristics of high portability and scalability. At the same time, it avoids the problem that product training is prone to accidents directly under the condition of high alert.

2. Summary of Simulated Training System

Missile weapon simulation training system is to make full use of computer information technology, simulation technology and software technology to carry out integrated training of simulation, actual combat and specialization. By building a fault library with certain complexity, openness and constructability, it can simulate the possible faults in missile testing process, so as to improve the level of skilled operation of weapon system in the army. Battlefield emergency response capability. The

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whole missile weapon simulation training system should include missile test training system and missile fault elimination training system. It has the following characteristics:

1) Authenticity. The ultimate goal of missile weapon simulation training system is to enable officers and soldiers to operate weapon test equipment skillfully, which necessarily requires that the missile weapon simulation training system can be as same as the real test equipment as possible to create a real scene and feelings.

2) Flexibility. Because the whole missile weapon simulation system is built with computer information technology, simulation technology and software technology, it can achieve more emergency settings and ensure flexible fault settings according to the actual situation, which can often better exercise the trainees' ability to deal with emergencies.

3) Convenience. The missile weapon simulation training system is easy to organize and implement.

4) High efficiency. The missile weapon simulation training system relies on the existing network room of the army, and the training field can be effectively guaranteed. It can realize single training and group training without the limitation of the number of trainees. The training time is flexible, and the training efficiency can be greatly improved.

5) Highlighting the focus. The simulation training system of missile weapon can concentrate time and energy on training key subjects, while giving consideration to the overall situation, it can also highlight the key points.

6) The process is known. The simulation training system can use its own software recording function to record the trainees' operation steps, problems encountered and solutions in detail, so as to better find the problems of the operator.

However, at present, the missile simulation training system is designed independently by military units, colleges and industrial departments. There is no unified top-level planning. Various types of missile training system can not form a standardized and systematic design structure. As a result, every missile model needs to be redesigned, and a lot of unnecessary duplicate work has been done, resulting in a great deal of waste of manpower and material resources. In this paper, A simulation training system based on MVC framework is hoped to established, which can provide a model for the follow-up simulation training system of missile weapons.

3. MVC introduction

Model-View-Controller (MVC) was started in the 1980s. It was first used in desktop applications and later in Web applications. The purpose of MVC framework is to isolate the model representing data and logic from the human-computer interaction interface by the controller, so as to improve the efficiency of software development, ensure the stability of the software development process and the scalability of the software in the later period, and improve the maintainability.

Model is mainly used to encapsulate business logic and data model. It is mainly used to abstract the functions of applications, encapsulate the structure and operation of program data, provide access to program functions to controllers, accept data query requests from views, and notify interested views when data changes.

View is used for user interface to realize interaction and data input and output. View has the function of interacting with users and is the interface between application system and users. It abstracts the data and presents it to the user. At the same time, it obtains user input and forwards it to the controller. Update the display information when the data from the model has been updated.

Controller links model and view to control the whole business process.

The controller converts the view into standard business events by capturing the external information, and then parses it into actions that the model should perform (such as activating business logic and changing the state of the model). At the same time, the update and modification of the model will also notify the view through the controller, so as to maintain the consistency between the view and the model. The block diagram of the design pattern is shown in Figure 1.

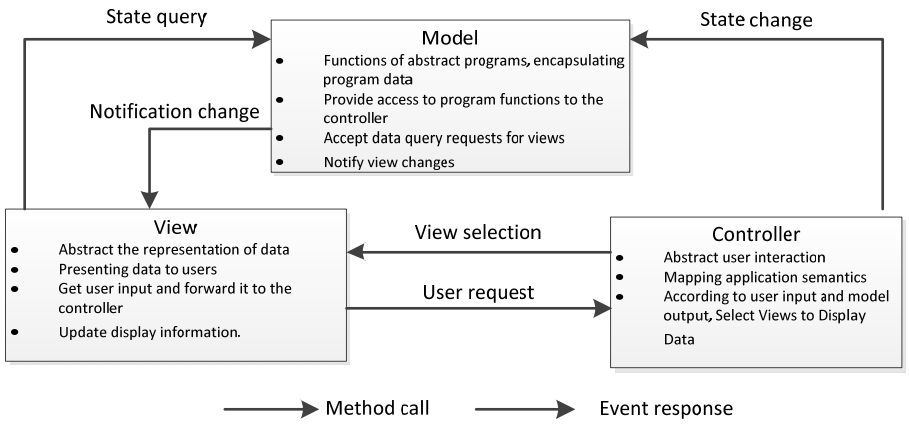


Figure 1. MVC architecture

As it seen from Figure 1, the three components of MVC are separated from each other, and the loose coupling and high cohesion among the three parts of model, view and controller are realized. MVC has many advantages because of its characteristics:

High reusability. Separating views from models, they can change independently, which greatly improves software scalability, cross-platform, versatility and portability.

Low coupling. Separating models from views means that models can be independently extended and modified without impact.

Rapid development and easy deployment. Models, views, and controllers are isolated so that developers can design independently.

4. Design and Implementation of Simulated Training Platform

In all kinds of missile weapon simulation training systems designed in the past, data and models are coupled together, that is, the whole system contains all phenomena and processes, and the whole system is controlled by time series flow. This design method is relatively simple. It only needs to fix the whole process in a sequential manner in the program. However, once the publication is generated, it will be very complex to modify it, and the maintainability and modifiability are poor. Therefore, this kind of design only applies when the whole missile weapon system has been formed and will not be changed. However, with the development of science and technology, the current missile weapon system is always updated constantly, with more batches of missiles and greater variability of the test process; different missile launching tasks will also lead to different test processes, so the simulation training system can not follow the actual changes of the army, resulting in the simulation training system can not continue to use, resulting in great waste.

Using MVC framework to build the whole simulation training system, the whole process and phenomenon can be separately put into the database and read by using model layer. When the missile batch or test process is changed, the process and phenomena in the database can be changed to adapt to the change, so that the simulation training system can always match the actual missile weapon system, and achieve the purpose of a model of a simulation training device. Using model view architecture can better separate view from business logic, improve the efficiency of system development and reduce the cost of later maintenance.

Based on the above considerations, the simulation training system is divided into view layer, control layer and model layer according to MVC architecture, as shown in Figure 2. View layer includes user interface view and simple interface logic. It is mainly responsible for data display of view components. The control layer implements the business logic of the system, completes model operation, message distribution and view control. The model layer mainly reads the data to isolate the coupling between the data and the model, and realizes a set of simulators to meet the requirements of multiple batches of missile weapons.

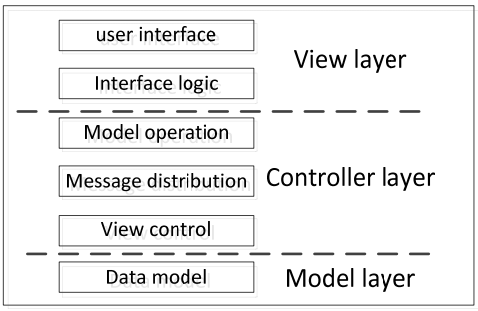


Figure 2. System architecture

4.1.Whole Framework Design of Simulated Training System

A missile weapon test system is divided into four interfaces. The distributed measurement and control system centered on the central computer is adopted, and the information transmission with the missile is realized by using CPCI bus. During the whole test and launch process, the central computer controls the ground test system and tests the missile control system according to the pre-programmed test flow through the test, launch and control program installed in the center computer.

Because of the technology or missile weapon itself, all kinds of simulation training systems designed in the past often add physical objects to make the simulation training system more realistic. But this design makes it difficult to popularize the training system in grass-roots units. In order to make the analog training system play a better role, the current development trend is to use a complete software program, even using computers to virtualize the buttons, lights, switches and other controls, through the interconnection of several computers to achieve the simulation of the test system.

The whole simulation training system is divided into two parts: server host and client slave. Server host model layer and host control layer. Client slave includes slave control layer and view layer. Server host and client slave adopt C# language of ZeroMQ under .Net platform to realize version NetMQ, and realize message exchange and forwarding. The host control layer mainly implements model operation, message distribution and view control functions. The slave control layer implements message structure and view control functions. The control layer mainly implements table-driven model operation. The overall framework of the simulation training system is shown in Figure 3.

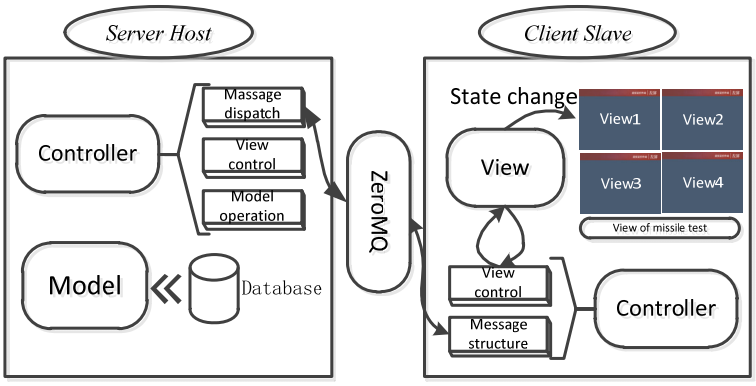


Figure 3. Overall framework of simulated training system

4.2.Implementation of Client Slave

Client slave is the terminal of analog training system and the interactive interface between the system and trumpeter, including view layer and slave control layer. View layer is mainly used to read the trumpeter's operation action, and pass it to the control layer to realize interaction. At the same time, it receives control layer instructions to change the various states and phenomena of the display operation interface. The slave control layer is mainly used to receive the instruction message sent by the host control layer, update the system conditions, notify the view layer to change the phenomenon and state;

on the other hand, it receives the operator operation information from the view layer and passes it to the host control layer through the network layer. The client slave framework is shown in Figure 4.

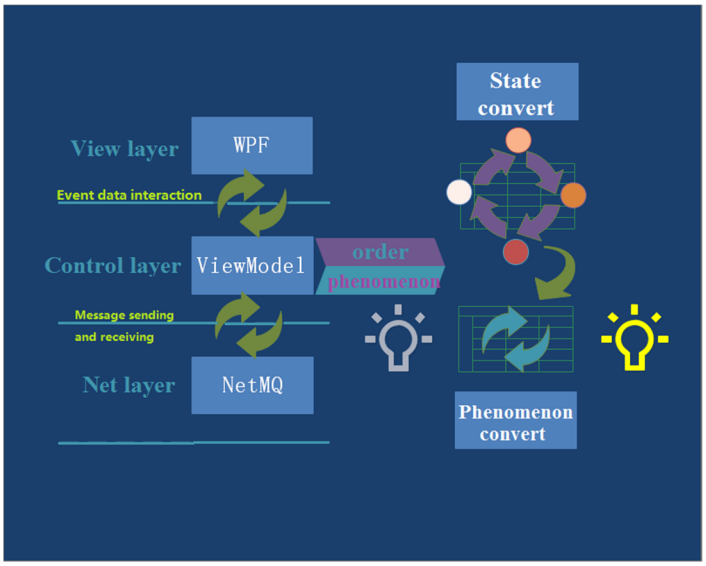


Figure 4. Client-side slave framework

4.2.1.Implementation of View Layer

The view layer adopts WPF (Window Presentation Foundation) technology. WPF is a new generation of Microsoft graphics system. It provides a unified programming model, language and framework for user interface. It separates the logic of view layer and data layer better, and realizes the virtual and data-driven display of all components. WPF is a technology and tool specially used to write the presentation layer. It can concurrently produce the virtual control library of WPF components to improve the reuse level and development efficiency. At the same time, it supports the use of Extensible Application Markup Language (XAML) to write the view layer. XAML is a markup language that publicly represents the user interface of Windows applications. It separates the UI design from the basic code and truly separates the interface from the logical layer.

The view layer also needs to implement simple interface logic. After receiving instructions from slave control layer, the view layer changes the display information by querying the resource dictionary.

```
</Window.Resources>
    <DataTemplate x:Key="……">
      <Grid >
      <!-- Setting the initial display status/phenomenon -->
      ……
      </Grid>
      <DataTemplate.Triggers>
      <!-- The condition triggered change display / phenomenon -->
      ……
      </DataTemplate.Triggers>
    </DataTemplate>
      <!—Other resource codes -->
      ……
  </Window.Resources>
```

4.2.2.Implementation of slave control layer

The slave control layer mainly implements message structure and view control functions. The slave control layer changes its internal state after receiving the instruction message from the host control layer, changes the corresponding system conditions by looking up tables, updates the system, and then publishes the phenomenon in the form of messages to notify the view layer of the change of state. At the same time, the trumpeter operation information is obtained from the display layer, and then

returned to the host control layer to issue new message instructions. The code structure is shown in Figure 5.

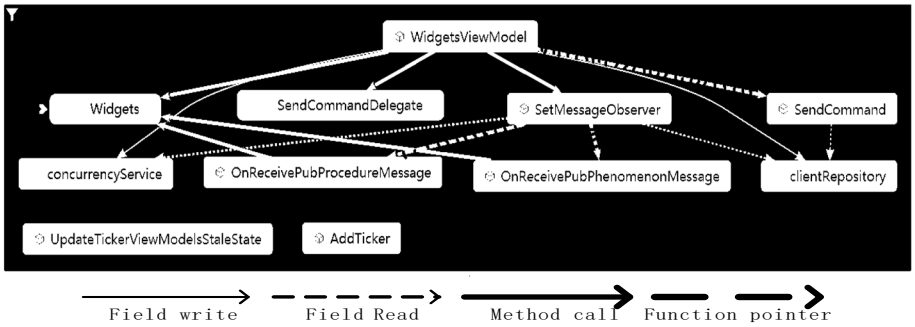


Figure 5. Host Control Layer Code Structure

4.3.Implementation of Server Host

4.3.1.Implementation of Model Layer

According to the analysis of missile weapon test process, considering that phenomena are closely related to operation in the process of missile weapon system test, that is, when a button is pressed, a fixed phenomenon will occur, or when a condition triggers, a certain phenomenon will occur. Based on this, the whole operation will be divided into instruction list, system condition table and phenomena table to control the test process.

Instruction tables, phenomena tables and system condition tables are implemented by internal maintenance hash tables. The instruction list consists of a set of instructions and conditions, recording the conditions and conditions that each control needs to satisfy when issuing instructions. The phenomena table is composed of a set of conditions and phenomena, which records the conditions that need to be satisfied when the state of the control changes. The system condition table records the various sub-conditions contained in a set of conditions.

The model layer reads the information of three tables and then passes it to the host control layer. The reading method is shown in Figure 6.

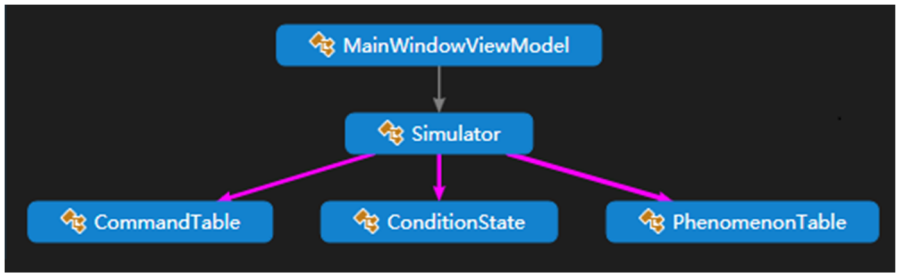


Figure 6. Model Layer Reads Data

4.3.2.Implementation of Host Control Layer

The host control layer mainly implements model operation, message distribution and view control functions. Using instruction list and phenomena table, on the one hand, the received messages are processed, on the other hand, new messages are issued. After the system receives the instruction, the internal state changes, and the corresponding system conditions are changed by looking up the table. Then it is implemented by transferring the network layer to the slave control layer.

4.4.Implementation of Network Layer

The network layer uses C# language of ZeroMQ under .Net platform to implement version NetMQ, and to realize message transmission and forwarding. ZeroMQ is an information-oriented open source

middleware library developed by iMatix. It can run on most modern platforms and has the characteristics of fast running speed and high scalability. Pub-Subs publishing and subscribing mode is adopted between master and slave computers to distribute component messages after updating. Router-Dealer mode is adopted between slave and host to realize asynchronous transmission of control information from slave to host, which enables the host to respond to multiple slave responses simultaneously. The REQ-REP mode is adopted internally to realize asynchronous processing of message flow in network layer and control layer.

4.5.Evaluation of Simulated Training System Based on MVC Framework

1) Separate the interface from the process. Interface phenomena display and smooth control are separated, data and model are decoupled, which improves the maintainability and modifiability of the system, realizes the goal that different batches of missiles can use the same simulation training system, improves the development efficiency of the system, and reduces the later maintenance cost.

2) Using MVC framework, it provides a unified design framework. Using MVC framework, the server, data structure and display interface are designed separately, which provides a reference and imitative design framework for later design of various types of missile simulation training system, and changes the situation of each type of missile simulation training system fighting separately in the past.

3) The use of ZeroMQ middle layer provides a unified communication scheme. By using the characteristics of ZeroMQ, such as high performance, asynchronous processing and simplicity, a message middleware can be directly used for the communication of missile simulation training system in the future. The missile greatly reduces the design difficulty of missile simulation training system in the future.

5. Conclusion

Under the background of more and more in-depth concept of combat-oriented training, computer training will provide great assistance to combat-oriented training. The goal of strengthening the army in the new era puts forward more stringent requirements for the development of missile troops. The existing training methods must be changed, earnestly implement the important instruction of the Central Military Commission that "using computer technology to carry out simulation training is the development direction of our army's training", promote the effectiveness of missile troops' training, actively promote the operational conditions of information simulation training, and effectively improve the combat effectiveness of missile troops missiles.

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