A model-driven system interface design method based on MVC pattern

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Abstract. In Electronic optical tracking system human-machine interface design process is used to simulate the console more digital implementation, not for a variety of interface between model design and model conversion problems and analyzing the availability of this situation, this article based on the interface of model-driven development research field, puts forward a new model based on the drive and friendly human-computer interaction interface design framework, studied how the presentation model set and using the MVC pattern of the organization's program tools, in addition to the view model independent from the general MVC pattern, add visual information structured design module. At the same time, the feasibility and advantages of the new framework are proved by an example.

1. Introduction
At present, the research and application of information technology and human-computer interaction are developing rapidly. Human-computer interface, as the interface between human and machine, directly affects the performance of the system and is of great importance. At present, the human-computer interface of the electronic optical tracking system is only a digital realization of the analog console, which is a semi-text and semi-model driven way. The lack of systematic and original research on the human-computer interaction interface design leads to a certain gap between the human-computer interaction mode of the photoelectric tracking system and civil electronic equipment. The electronic optical tracking system also needs to establish a stable and reliable human-machine interface framework to ensure that the interface model design conversion and interface availability meet the requirements. In this paper, a new framework of composite MVC pattern and visual information structure is proposed to solve this problem, so that the transformation of high statement model can be linked with mature toolbox, ensuring the effectiveness of the interface model.

2. Method analysis of model-driven interface
The core of the model-driven approach is to use models to drive the whole user interface design process, that is, to state and build the interface and its components in different stages through a number of related models [1]. Model-based design aims to identify high-abstraction level models that allow designers to specify and analyze interactive software applications from a more semantically oriented level, rather than immediately starting to deal with the implementation level. This allows designers to focus on more important aspects, such as the rational design of the interface, rather than immediately focusing on many
implementation details. Has been put forward in the study of the early model driven abstract model of all levels and define the UI, the model in CRF group work under the level of abstraction are defined, Cameron reference framework was proposed, won widespread recognition and support of the project, the respectively: the definition of the concept of task and abstract interface, the interface, the resulting interface [2].

CAMELEON framework describes interface interaction behavior models are mostly declarative models, which are convenient for high-level semantic description, but cannot be directly executed. In the process of transforming tasks into interface elements and interaction functions, the implementation model of the interface and the declarative model may be inconsistent. Given the availability of the final interface implementation, specific constraints need to be imposed on the model design.

MVC pattern is one of the most commonly used software design patterns. Its core is to divide system functions, realize weak coupling between data layer and function layer, and make presentation layer and business logic relatively independent. It is suitable for developing applications related to user graphical interface. The MVC pattern includes a controller that handles user commands and program events. Model to maintain data and provide data access methods; The view, which is responsible for displaying the data and making user requests to the model and controller [3]. Using MVC pattern to limit the presentation model can effectively solve the linkage problem between the interface of model transformation and user interface toolbox, and ensure the usability of the final interface.

The consistency between the human-machine interface implementation model and the presentation model is the premise to ensure that the interface design information can be effectively transmitted. The MVC pattern can make the presentation model naturally link with the ecological user interface toolbox to form effective reuse.

In addition, according to the principle of cognitive load [4], the interface can shorten the time from perception to understanding by constructing the visual information structure. Visual information structure can be divided into two aspects: content layout of interface and structured presentation of information entity data. The complex system has a large amount of information and data, but the display carrier size and pixel are limited, so a large amount of data needs to be displayed on multiple pages, which will increase the cognitive load of people and cause the operator to "get lost" in a large number of display pages. Hierarchical structure makes the digital interface information presentation more organized, the relationship between the pages more clear.

1) the grouping of interface contents can make the interface clear in hierarchy, structure and layout through lines, colors and Spaces;
2) structured design of information entities and data in the interface, layout of interface content and structured information entity data.

However, the process of visual information structure design is not fully integrated into the whole process of model-driven human-machine interface development, and the structural design of visual information is not substantially related to the model.

After it is effectively linked to the established user interface toolbox, the visual information of the interface can be specified. The mature user interface toolbox can be used for the structural design of visual information of the interface to ensure friendly human-computer interaction.

The role of the interface framework is to consider the architecture of interactive systems. The visual information structure module is added into the framework, and the relevance of each model level from domain model, task model and user interface model is taken into account, so as to fully ensure the usefulness and availability of the system. On the other hand, the MVC pattern is used to deconstruct the interface to ensure that the interface design and implementation process is natural and effective.

3. Framework implementation and model design
Based on the ideas mentioned above, this paper proposes the framework shown in figure 1, which takes into account the model hierarchy of CAMELEON framework and the MVC pattern architecture, and emphasizes the importance of the visual information structure model to integrate structure, function and tools.
The model hierarchy within the framework follows the definition of the Cameron reference framework, which divides the whole model-driven interface development process into domain model, task model, interface model and final interface from the abstract to the concrete.

3.1. Domain Model
The domain model is equivalent to the "model" in the MVC pattern. Its function is to integrate the core functions of the human-machine interface, separate functions and interactive data from the presentation layer, and facilitate the interface model to invoke the core functions realized by the interface through the interface of the task model in the process of interface development.

3.2. Task Model
The task model can be used as the "controller" part of the MVC pattern to describe the timing and logic of the user's task, the activities involved in completing the task, and the domain model interface and interface elements involved in the activity. In this paper, ConcurTaskTree (CTT) 's task marking method and operation symbol are used. The symbol semantics of CTT model are very rich, and it is capable of complex and dynamic task description [5]. It is a semi-executable model. The operator semantics of the CTT model can effectively represent the temporal and logical relationship of the task world and ensure the validity of the interface model.

This paper defines these user interface and behavior descriptions as static task decomposition and dynamic action sequence documents. They become part of the components of the MVC pattern, generating controllers in the MVC pattern program that control the dialogue and invocation of the interface model to the domain model, ensuring the semantic consistency of the presentation model to the final interface.

3.3. Interface Model
The interface model belongs to the "view" part of the MVC pattern. As the presentation layer of the interface, it defines the element, component appearance and logic of the interface. According to different stages of design, it can be divided into abstract interface model and concrete interface model. Abstract interface model is the abstract representation of the user interface, which does not involve specific platform information, but only classifies the interaction types of interface elements and organizes them structurally.

The concrete interface model is transformed from the abstract interface model to describe the user interface model with context information added. The transformation rule is similar to a stylesheet, where all mapping relationships are documented in the same vocabulary, and it visualizes the interaction...
elements of an abstract interface as platform-specific interface elements and links them to mature interface toolkits so that vocabularies can be reused. At the same time, the existing hierarchical interface elements need to be structured to design the visual information of the interface in order to be transformed into the final user interface.

3.4. Structured Visual Information
In the process of model transformation-driven interface development, the operation mode of the interface is the operation chain determined according to the preliminary model designed by the designer. For the same task, there may be different operation chains and specific operation modes in different contexts. The design of visual information structure needs to be completed according to the operation chain given by the abstract model.

Visual information can be designed by directly calling the interface toolbox to control elements in the interface model, such as QT tools that also use the MVC pattern.

Whole new framework is a collection of model, using frame at the beginning of the model is made a provision for availability, conducive to the MVC pattern has carried on the limits to the model and the specific design, and to eliminate interface development tools commonly used system in the practical application of problems on the influence of interface design, effectively improve the efficiency in the process of the interface development, and ultimately the rationality of the interface, and for photoelectric tracking system of human-machine interface in the form of development provides the possibility.

4. Framework application
In order to verify the effectiveness of the design method, this paper carried out the verification in the interface development of the Electric optical tracking system, adopted the interface development framework and model design proposed in this paper, developed and designed the main control software interface of the photoelectric tracking system. Taking the system parameter setting interface as an example, the process of building the model and using UIML interface to describe the file is shown in figure 2 and 3.

The abstract task of system parameter setting is modeled, the task is decomposed, and the subtasks are prioritized by using operators, as shown in figure 2. The task model is transformed into an abstract model, and a mature interface toolbox is used, such as PYQT5 in this paper, to structure the visual information of interface elements in the abstract model, as shown in figure 3.
During the whole development process, during the model design period, the focus can be placed on the task logic under high abstract semantics, and the operation chain of tasks can be designed properly. At the same time, according to the MVC pattern, the interface model is effectively linked to the interface toolbox, which improves the efficiency and operability of development. It can be seen that because the architecture of the system is implicit in the model design, the availability of the system is guaranteed and the problem of the executable of the stated model is solved.

5. Conclusion

Human-machine interface based on electric optical tracking system, the problems of exploitation is analyzed based on some problems of the interface of model driven development method, this paper proposes a combination of CAMELEON framework and MVC pattern model driven interface development framework, integrates various model and visual information structured module, and in the actual development project of the framework is verified. Model-driven user interface design framework based on MVC pattern solves the problems of traditional user interface development to some extent, and has the following advantages:

The implementation of the presentation model can be realized, so that the model design is closely connected with the code implementation, effectively solving the problem of the description unity between the presentation model and the interface model;

Make the interface designer pay more attention to the design of high-level abstract semantics of the interface;

It can effectively guarantee the usability of the interface.

This framework is mainly suitable for the development of the human-machine interface of the optoelectronic tracking system and the similar complex analog digital monitor system.

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