The Key Technology Research and Application of Re-configurable Real-time Data Process System

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ABSTRACT

In aerospace launching mission, the requirements of the tracking and control system are frequently changing, which cause the high costs of software maintenance and low software reliability. To solve this problem, we research some key technologies in designing a reconfigurable real-time data process system. According to the characteristics of the tracking and control information, an information description model, a processing method model and a processing tree model are presented. Based on these models, re-configurable real-time data processing system architecture and resource configuration methods are proposed. The proposed methods improve the data processing system’s rapid adaption ability to new mission and new processing requirements.

INTRODUCTION

With the development of aerospace industry of China, the aerospace launching missions have become more and more frequent. The types of these missions are quite different, some missions are launched in parallel, and the experimental state is frequently changing. In the experimental mission, different kinds of measuring and controlling equipment are used to collect experimental information in real time, the information is then transmitted to the command and display system. The command and display system should provide different kinds of correct measuring information to commanders and technicians in time, to help them in checking the parameters of the aircrafts and decision making. To meet the requirements of diversity and changeability of the aerospace launching mission, a reconfigurable real-time data process architecture is proposed.

RECONFIGURABLE MODEL DESIGN

Data Description Model

In order to solve the problem of the reconfiguration of data processing, the process can not be hard coded in the program. Firstly, the data objects should be formalized via the abstraction of the data object by designing a byte stream object model with the Composite model (Bytes Object Model, referred to as BOM). BOM model can describe the sequence of bytes consisting of several bytes, a BOM object is given to describe the structure of a sequence of bytes of data corresponding to the information, including the byte length, data type, processing method, etc. The static type structure of the BOM
model is a layer derived tree structure, in line with the characteristics of hierarchical definition. The topmost layer is the BOM abstract class, which is the base class for all BOM classes, and the other BOM classes are derived directly or indirectly from the BOM base class. The BOM classes fall into two broad categories: Section BOM and CompositeBOM. The class hierarchy of the BOM model is shown in Figure 1. The abstraction description of the data model has expressed a strong ability, good versatility, flexible and extensible advantages [1] in solving the problem description of complex data, and it has been used in space mission data processing software, Figure 2 shows the commonly used data derived model.

![Figure 1. BOM model class diagram.](image1)

![Figure 2. Data model class diagram implemented by the system.](image2)
Data Processing Method Model

Based on the created BOM, the structure analysis of data stream is realized, and the data stream is transformed into effective data source field. These valid data source field by dimension conversion, calculation formula and other methods eventually transformed into physical quantity effectively, and to carry out comprehensive treatment of physical treatment out of the final result, based on the data processing method of formal description. Through adding field processing method for processing field attributes specified in parsing after the source encoding structure of field data, a sequence of data processing can be generated via the data processing method of dynamic scheduling, dynamic loading method. Figure 3 shows the commonly used processing methods, and model classes.

![Figure 3. Data processing method model class diagrams.](image)

PROCESS RECONFIGURATION

According to the task need, the data Designer (DataDesigner) is designed to change processing object, data processing method, structure analysis and reconstruction, using BOM model and data processing model. The reconstruction of the analytical results according to the chain combination mode of record keeping quasi file in XML standard (DataSchema) [2,3]. According to the DataSchema file, the Processing monitor (ProcessMonitor) is designed to receive the real-time data processing and reconstruct the processing. Based on the clustering algorithm for data object classification and perform the reconstruction, the desired results can be obtained. Figure 4 shows the class diagram of the processing flow.
METHOD APPLICATIONS

To verify the architecture and method proposed in last sections, a real-time data process system for aerospace launching mission tracking and control is implemented in the WINDOWS using Microsoft's Visual 2010 development platform and C# language. The user interface of the software in the custom state is shown in Figure 5.

An ecosystem with custom state, ready state, running state[4] is built. The system builds up the data model component library of the corresponding data description model in the form of component library, corresponding data processing method, model processing method, component library, and so on[5]. In the custom state, through the data model and method model of component configuration, formation process of each kind of control information frame definition, data resource files, records the relationship between dynamic process and process the data of each class. The ready state load data processing method, the operation state according to the analytic processing method carries on the real-time processing, and produces the processing result. The system is running, either returning to the ready state, reloading the data processing method, or directly returning to the custom state to redefine the data processing method. Figure 6 shows the main process and the state transition relationship of the software.
Figure 5. Custom UI.

Figure 6. Reconstruction of data processing implementation.
CONCLUSIONS

Based on the space measurement and control task, according to the characteristics of information control, an information description based field data model is proposed, including bit data model, time data model, combination data model, processing method model based on results of the flow of information. On the basis of these models, the framework of three custom states is designed, including the designing state, ready state and executing state. The designing state is designed mainly to complete the process of generating custom state tree, the ready state’s job is to complete the main data communication interface, create thread processing, the running state’s job is to accomplish real-time data receiving and processing. Through the above design, the application software has the ability to deal with the data frame, and can meet the expansion requirements of the data frame types, parameters, processing methods and changes in processing results. The developed application system has effectively improved the adaptability of data processing.

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