Prototyping a Geological Processing Service System Using Message Scheduling

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Abstract: As the high-speed and parallel processing features on FPGA, so it is widely used in high-speed information processing system. In this paper, the front-end data of X - ray energy spectrum is taken as processing object, high-speed data acquisition and processing methods based on the FPGA are proposed, which embodies the advantages of FPGA in the application of high speed information processing. The compensation measures in the electronic measurement system are also discussed in this paper.
Keywords: FPGA; High-speed Information Processing; X-ray energy spectrum; Electronic measurement system; Compensation measures

1. INTRODUCTION

The front-end data of X-ray energy spectrum is millivolt voltage pulse sequence, the pulse width of the sequence is microsecond level. But the amplitude and number of the pulse sequence contains the is sed system is FPGA as the control core. The data acquisition and processing system is composed of program control amplifier(PCA), A/D converter, FPGA unit, MCU unit and FIFO interface unit. The system block diagram is shown in figure 1.

Abstract: Geological processing service can involve the integration of multiple software modules into a single codebase. These modules are often written by non-software specialists, using heterogeneous terminologies and modeling approaches. Hence, the knowledge base necessary to quantify geological services is broad and derived from many diverse scientific disciplines. Building the required models is especially challenging as modelers from different locations and times may develop the disciplinary models needed for geological processing, and these models must be identified and made accessible to the interdisciplinary simulation. To address this need, We propose the geological processing service system using Message Scheduling, solving the reuse problem of Geological Data Services and Processing Services. To demonstrate our approach,We developed an online processing services flow,which are combined to form complex services, and may be reused in other similar contexts. This work was carried out under the auspices of the GeoCloud project funded by the Geological Cloud program.
Keywords: g Geological Data Services ; Processing Services; Message Scheduling

1. INTRODUCTION

With the development of national land survey in china, the application of information technology in geological survey is more and more in-depth, and more and more information systems are serving geological exploration. These algorithms library and application software algorithm is complex and special, it is difficult to redevelop. Meanwhile, with the development of Internet, Such as cloud computing and Big Data technology, it is urgent to share geological data and these processing algorithms in the form of web services. Currently, in the field of geoscience web service sharing, it is generally through building a service-oriented architecture (SOA) system (Feng M., et all.,2011;Carlos G et all.,2010; Benjamin et all.,2007) following the OGC WPS (Web Processing Service).

In sharing of geological information web services, the geological data sharing based on OGC has made considerable progress(Tan Y.,2016; Hu L.,2016; Wang J., et all.,2014), formed a relatively perfect system and satisfied the geological data sharing service. However, it is difficult to meet the sharing of geological algorithms based on OGC WPS service, which is determined by the characteristics of geological data processing service: Geological resource, including Geological, Geophysical and Geochemical Exploration, Oil and Gas, Drilling and other data, the volume of data processing is relatively large. Meanwhile, different types of geological data,corresponding to the geological processing algorithm is complex and diverse. Additional difficulties include redeveloping the geological processing web service when following the WPS service.Therefore, how to reuse geological algorithm library or application software to quickly build a large data-supported web sharing service system is an urgent problem(Jiang Z., et all.,2007).

Message scheduling, also known as message queue scheduling, belongs to the middleware part of the

system and is an important component in distributed system. Its working principle is to coordinate the application among components or modules in the system through messages. It is an indispensable middleware for large-scale distributed systems to realize high performance, high availability, scalability and final consistency architecture. Message queues generally include four modes: one-way scheduling mode, callback mode, polling mode, publish / subscribe mode. Each mode contains three roles: message queue (queue), sender (sender) and receiver (receiver).

In view of the encountered in the sharing of geological processing services, combining with the analysis of the concept of message scheduling, a sharing of geological processing services based on message scheduling is proposed. The mean is mainly to extend the support of message interface based on geological algorithm library and geological application software, not to change the architecture of existing algorithms or application systems, by reusing these geological algorithm libraries or processing application software while satisfying the requirements of geological processing services on the Internet. Meanwhile, this mechanism can also dynamically select the processing capacity of the supporting algorithm according to the concurrent number of Internet requests or the size of uploaded data to ensure that the server will not crash for the processing data is too large.

This paper designs a geological service architecture based on "publish/subscribe" message service mode, and introduces the key technologies such as the structure of geological message body, geological message model, geological service classification, and geological algorithm service encapsulation. The application of message dispatching mechanism in geological service system is demonstrated by taking the on-line processing service of geological process as an example. The practice shows that message dispatching mechanism can meet the rapid development of geological service and better meet the application requirements of Internet and large data.

2. GEOLOGICAL SERVICE INFRASTRUCTURE

2.1. Architecture of services

In the architecture design of new geological service system, the following aspects are considered: first, reuse the existing algorithm library or application software, which is the first principle of system architecture design. Otherwise, the system will need large-scale algorithm re-coding, increase the development cycle and waste the existing research and development system. Secondly, after the algorithm library is re-encapsulated, it can not only ensure the use of the system, but also ensure that other third-party systems can invoke these algorithms library; thirdly, the algorithm services and websites remain loosely coupled, website changes do not affect the continuing service of the algorithm library services.

Considering the above architecture design principles, a geological service system is constructed based on the "publish/subscribe" mode of message scheduling. Its structure is mainly composed of the following 4 main parts in Fig.1:

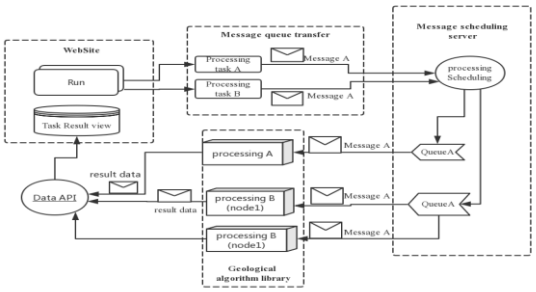

Fig.1 Architecture of Geology Service

1) System Web Module. Mainly is the website design and development, provides the geological algorithm service interface, obtains the geological processing need parameter item. Trigger the execution operation, send the processing message, and visualize the result data after the geological algorithm library processing.

2) Message Queue Transfer Module. Mainly includes the geological processing related parameters and data messaging, parameters include the name of the message queue, geological algorithm processing parameters required items, data storage address, etc.

3) Message Scheduling Processing Server. Mainly bears the turnover of message body, exception handling of message body and load balancing of message body, and makes distributed scheduling according to the frequency of message queue execution.

4) Geological Algorithm Library Module. It is a software module for geological processing and geological application. Receive the message from the message dispatching server, carry on geological operation, generate the result data, and publish the geological result data in the form of OGC WMS or WMTS (Web Map Cache Service). Provide data access interface for the sub-module of the system platform.

2.2 Geological message structure and Processing service mode design

Geological message structure is the basis of message scheduling service system, and the design of message is related to all aspects of the system architecture. The design of message structure granularity is the key to the success of message design. Message granularity is too coarse, background algorithm library becomes a unified whole module, Which is difficult to distinguish message requests; Message granularity is too fine in geological processing algorithm library, there will be an algorithm corresponding with a message queue, a processing

node, forming a huge algorithm processing node. Considering the processing types and practical requirements of services in the system, a suitable message body structure is designed, which contains parameters as shown in Table 1.

Table.1 Parameter name, code name and type of geological message body

Code	Type	Description
Id	Number	messa
UserID	Number	system
GeoServiceType	String	types
ServiceName	String	Chines
ServiceEnName	String	Englis
DataAddress	String	data se
Param	Number	geolog
AlgorithmName	String	name
AlgorithmID	Number	geolog

Considering the situation of geological processing service, Publish/Subscribe mode is adopted in the geological message model. First, the library module is registered in the message scheduling service system including names of the algorithm library, names of the algorithm queue, algorithm publisher, description and other information to form a message queue service library, with convenient for service query and browsing. Secondly, in the System Web Module of the system, users need to register parameters needed for geological processing, including selecting data items, algorithm parameters, request mode and other parameters, executing processing service requests, generating geological processing message queues and message bodies, publishing message queues; Thirdly, Geological Algorithm Library Module, subscribing from the message queue service library corresponding to meet the requirements. Message queue is processed by oneself. When message from Message Scheduling Processing Server is monitored, message body is received, then message content is parsed and passed to the inner module of the algorithm processing, processing result is generated, and geological spatial data service module is invoked to generate data service interfaces such as WMS and WFS that conform to the OGC specification. The interface information is pushed to System Web Module of the system, which receives the data from the algorithm library module, and displays with WMS and WFS interfaces. Show the results of the process to users through browsers.

2.3 Classification design of geological processing service

Existing geological processing algorithm library or application software has various categories and complex functions. Under the geological service system of message dispatching, its functions are classified and sorted. According to basic algorithm, spatial data processing and business processing methods, it can be divided into two categories: Geological Thematic Maps and Geological Processing. Geological Thematic Maps divided into routine mapping, drilling engineering mapping, geochemical mapping; Geological Processing divided into mineralization evaluation and prediction and land evaluation module. The specific classification is shown in Fig.2.

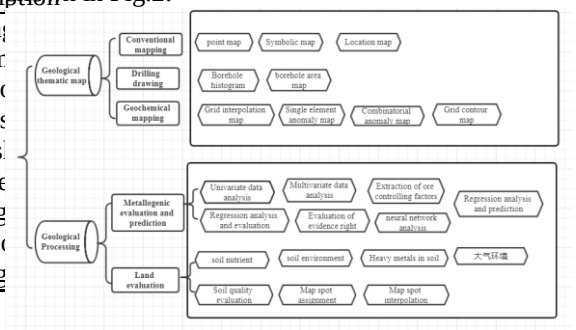

Fig.2 Classification Design Of Geological Processing Algorithm

3. SYSTEM IMPLEMENTATION

Research and Development of geological service system platform based on message dispatching mechanism mainly includes development of website, construction of message dispatching server, encapsulation of geological algorithm service interface and construction of WebGIS system. Encapsulation of message scheduling server and Interface of geological algorithm library is core of system development.

3.1 Software environment

The website is developed with Play framework and Java development language, which is mainly used for the design of front-end request page and invocation of processing service API; the encapsulation of geological algorithm service is the encapsulation of message interface based on the original system, which generally encapsulates C#. Net; Web server、load balancing server、message scheduling Servers and other unified deployment in the Docker environment, developing tools as shown in Table 2.

Table.2 Platform Development Tool

Tools	**Description**
Play	website development main platform
PostGIS	business database
Redis	memory database
RabbitMQ	Message scheduling server
Ngnix	load balancing server
Docker	computing environment
ArcGIS Server	webGIS server

3.2 Encapsulation of geological algorithm services

Existing geological algorithm library or Geological processing application service is encapsulated according to the service system of message dispatching mechanism. The main steps are as follows: Splitting the existing geological algorithm library or geological processing application, stripping the interface operation logic from the core algorithm library, and defining the input data type of the core algorithm library. Output data types, algorithm packages depend on the environment, algorithm to solve which geological problems, the formation of a standard algorithm library, usually a dynamic link plug-in library; secondly, comb the standard algorithm library, classify according to the algorithm function, and design the corresponding message body name and queue name according to the classification, forming a support message tone The third step is to develop the console program, call the algorithm function library, perform the relevant processing calculation on the request and the structure of geological message body, generate the processing results, and automatically publish them into the geological spatial data processing service.

After the algorithmic library is encapsulated, the system developer does not need to care about the development of the background algorithm, only needs to provide the data needed by the algorithm, while taking the existing algorithm greatly improves the efficiency of geological processing service system research and development.

3.3 Release of geological data sharing services

Publication of geological data sharing service mainly uses ArcGIS Server as WebGIS server to provide visualization service of geological data processing results. First of all, when the algorithm library is finished with geological processing, it will generate geological spatial data. The ArcGIS Server will automatically perform spatial data publishing service, publish geological data into WMS service conforming to OGC specification, and push the WMS address to the front desk of the website. The front desk will take the WMS address to resolve the WMS service address. The result of geological operation is displayed to the foreground of the browser, showing the result of geological algorithm to the user.

3.4 Geological processing message flow

Geological processing message system flow in Fig.3, the first is the browser provides geological online processing algorithm page, the user selects the page design geological algorithm method, upload the corresponding data, set the relevant parameters required by the algorithm, and then click processing request, in the user through the browser interface click processing request, trigger cancellation Information queue processing service, corresponding algorithm processing message queue, according to user registration parameters and uploaded data to generate geological processing message body, message scheduling server, according to the message queue name, and request data size, dynamic allocation of geological processing algorithm node; geological processing algorithm node when listening to message processing requests, Parse the message data into the data format needed by the algorithm, and transfer the data to the algorithm processing plug-in, perform geological operations, generate the result data, and call WebGIS online service publishing program, publish the result data generated by geological operations to OGC WMS service, push the WMS address to the browser through the message push server.

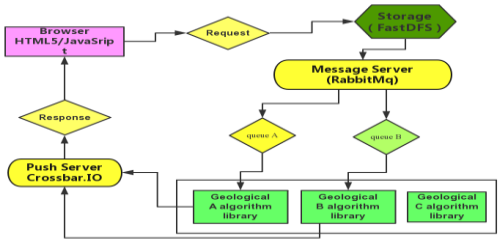

Fig.3 Flow of geological Message In System

4. APPLICATION

In practice, a browser-based prototype system for on-line processing of geological information based on information dispatching geological service system in Fig.4 is constructed. According to the classification of geological algorithms, the list of algorithms is displayed on the right function menu. Users drag and drop the functions to the middle process setting by dragging and dropping. According to the type of antenna, the input and output of the same type are connected to form a geological treatment process. Taking soil geochemical processing as an example, the data of element acquisition points are uploaded to Excel to form spatial data results through interpolation algorithm, contour line and isosurface algorithm.service of element geochemical anomaly map or multi-element anomaly map is obtained, and service of element anomaly map is formed and displayed in the result of process execution.

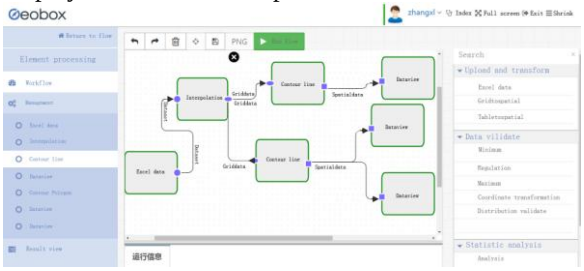

Fig.4 Work Flow Of On-line Processing System

5. CONCLUSION

As the development of information technology, especially cloud computing and Big Data technology, brings tremendous opportunities and challenges to the

application of information technology in the industry. Based on the new technology, this paper puts forward a new sharing structure of geological data processing service, and sets up the structure and service mode of geological message body under the framework. The classification design of the geological processing algorithm is carried out, and the application system of the model is preliminarily realized.Compared with the current mainstream service sharing algorithms based on OGC standards, this paper focuses on the reusability of geological processing algorithms to build application service architecture. The advantage is that existing systems or codes can be integrated into the platform without any changes, and the data generated by processing algorithms continue to follow the OGC standards. Visualization service adapts to the characteristics of rapid development of Internet system and meets the application requirements of Internet and large data. Next, the system will focus on solving the cloud management of application services, the geological processing algorithm library and other shared services transplanted to the cloud environment, to provide a wider range of application practices.

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