Development of Server to Service Cadastral Survey-Data

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Key words: Server, Data Service, Real-time Process, Control-Point

SUMMARY

This study was conducted because real-time data occurring at cadastral survey fields were managed as documents or even ignored due to absence of SW system to process. Importance of data can be recognized from the fundamental motto, 'data used once is highly possible to be used again'. As such, managing surveying data in real-time was investigated in this study. Therefore, a servicing environment for centrally integrating, operating and managing cadastral survey data, obtained from survey fields or offices, by means of the network is developed in this study. In addition, data collected at survey fields can be managed in real-time under such environment. Therefore, in this study, a high-performance data processing system for managing survey data in real-time is developed so as to service survey data in anytime and anywhere. In addition, the system is constructed to be operated in a systematic, integrated way. As a result, technology managing survey data is expected to advance along with the developing IT environment.

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1. INTRODUCTION

With development of the telecommunication technology, our society needs for wired/wireless devices and much network environment. In addition, more and more ubiquitous-based social infrastructures are also used. Methods collecting real-time data for utilizing such infrastructures have been continuously developed. However, in spite of the development of IT infrastructures, the traditional survey methods are still being used for managing data at cadastral survey fields in Korea. Accordingly, it required excess time and manpower. Moreover, because of the complexity in managing surveying result data many workers demand for management of real-time system in surveying field

2. DATA PROCESSING COMPONENTS

The objectives of this study are to investigate and develop components for servicing data obtained at cadastral survey fields. For the purpose, control-points used at survey fields was selected as a test model for servicing. As such, servicing and data processing with the model were investigated.

2.1 Network Server Environment:

This corresponds to the server solution in the conventional client/server network method. This server solution manages the analyzed data requested by survey workers in the wired/wireless environment, and provides standardized data as requested through the network. When clients connect to the server within provided network the server manages and process and provides surveying data in real-time.

2.2 Network Protocol

For improving performance and safety, the protocol transferring data is designed to move for much data through network, so that the clients using the protocol don't use database connector as ODBC.

2.3 Management Centralized Data

Wire network nodes and wireless network devices connect to server to process data of surveying results and then the server collect all data inputted by the connected clients. Then the data is managed by DBMS automatically at only one place.

2.4 Database Connection

I/O reference data to be serviced is organized to be loaded in three different databases (Oracle, MS-SQL Server). In order to reduce access time to connect to the DB, a multiple DB pooling technologies are used. In addition, DB connection method used in this study is ODBC to manage DB.

3. DEVELOPING KEY ELEMENTS IN DATA PROCESSING SERVER

The engine core, forming the data process server, comprises the multi-thread pooling module for processing network connection, the database access pooling module, the event management module for data process among individual threads, the system log management module for responding to unpredictable incidents, and the connection terminal management module. It can be divided into the wireless network and the wired network as external environmental components. There are client programs used by each network. In addition, there is a database inside the center network for managing survey data occurring at fields in real-time.

3.1 Multi-threading Data Processing

The data processing server is designed on the basis of multi-thread so that some problems such as effective resource allocation for CPU (Central Processing Unit) and system memory can be resolved. For the sake of acceptance and transfer for managing internally changed data, a critical area defining Semaphore and Mutex is prepared so as to manage information on changing data. A thread is created for each connection client. Socket receive wait, database transaction wait and process response wait for another distributed server part occur for processing of each connection client. They are processed by single thread so that interrupt for controlling additional servicing process time does not take place. In addition, in order to decrease response time of connection clients, the thread pooling module is used. By holding a limited number of threads, it checks if there is any 'sleeping' thread. If there is any, it wakes up the corresponding thread according to the given sequence so that the client request can be processed. For this purpose, the thread log management function is additionally formed so as to check thread outlines. In addition, creating threads supports activities of multiple connection clients, and individual memory area is allocated according to each activity. Therefore, when loading the data processing server, the pre-defined number of threads is created. Accordingly, if the corresponding thread is allocated during processing, response time for creating threads can be saved.

3.2 Modules for Improving System Performance

3.2.1 Scheduling

For the server module based on the time-sharing multi-tasking, it is critical which sequence should be used to perform programs. Therefore, in this study, in order to solve this, the scheduling sequence is organized by partitioning process in the unit of task so that data processing can be performed according to the sequence.

3.2.2 TCP/IP-based Socket Processing

Due to the characteristics of TCP, just keeping TCP connection also places significant load to the server. In this study, therefore, connection process is separated from the pure logic part by preparing a variety of parsers so as to respond to network-related problems such as

authentication process as to whether the connection is valid, decoding protocols, and protection from outside access to the internal server, as well as for the purpose of distributing TCP connection loads.

3.2.3 Interface and Log Management

The data processing server is designed to be run in the Windows operating system. The server is running in the form of daemons in a server computer where multiple CPUs are installed. At the same time when programs start to run, network information is checked so as to create the server socket. In such a case, a port to be used is designated by the administrator for security purposes. For the server system operation, after initializing the network, the thread pooling and the database connection pooling are run so that an instance of multiple connectors is created in 4 exclusive databases. Then, the system initialization is completed so that the response thread for the connection client enters into the wait mode. With the system interface, real-time usage history and status of the connection clients can be checked.

4. DATA MANAGEMENT STATUS

Data managed by the data processing server include reference data status, real-time GPS receive data, national digital topographic map, national lot number and facilities. The control-point and real-time GPS receive data are loaded in the database so that data can be input or output in real-time. For the digital topographic map, the nation is organized to a grid file with 10 levels so that it can be accessed and serviced directly from the service file. In addition, services of national lot number and facilities are loaded in the database so that they are used for data searching according to clients' request.

In particular, in this study, in order to test a model which can be connected properly to the existing status, the groupware actually used in Korea Cadastral Survey Corporation (KCSC) is used so that information on connected users and status related with infrastructures can be referred and utilized.

4.1 Designing DB Protocol

In order to improve performance and security of the system, pre-agreements of the data system between connection clients and the data processing server are defined by the protocol. The protocol can be divided into the header and the body parts. It also includes general status of connection clients and items to be serviced by the header. The body defines actual data values for service items defined by the header.

The key of the protocol designed in this study is to cross-reference search data of the database through the network communication. This contains record data and field status data of the search results in the database. The search results data is formed as packets in accordance with the pre-defined protocol.

4.2 Designing Database

The data management items for test used in this study comprise the control-point data used at survey fields and GPS receive data. They are formed in such a way that input, modification and search of data can be performed according to clients' request in real-time.

4.2.1 Control-point Management Basic Item

The serial number of the reference data designed for testing comprises 13 digits of 'city code(2)+district code(2)+ result registration(1)+reference type(1)+sequential number(7)'. Information on the serial number is automatically assigned in the data processing server so that there is no duplication in the numbers. The other major information contains items for searching and examining results.

4.2.2 Control-point History Management Item

The table for the control-point history is a table for managing checked status and whole examination for the control-point. Based on this information, current status for the control-point can be checked.

4.2.3 Control-point Node Management Item

The control-point node management makes it possible to manage information on parents nodes occurred during installation of the control-point. As such, it forms information for newly installing another control-point when damage or destruction of the network occurs.

4.2.4 Control-point Displacement Data Management Item

The displacement data management table is made for managing information on the displaced data of the reference position when the result is different from the drawing.

4.2.5 GPS Survey History Table

This table manages history for working with GPS reception. This table is organized to manage history of information on the GPS results.

4.2.6 RTCM Message

Data obtained from the GPS receiver is transferred to the server in real-time through the data transfer client. In such a case, when information of RTCM MESSAGE 18 type is transferred, such information is stored in DB. In addition, it can be transferred and serviced in real-time to clients which want to use the information.

4.2.7 GPS-NMEA Data Management Table

Data obtained from the GPS receiver is transferred to the server in real-time through the data transfer client. The client receiving GPS NMEA data manages the data in DB when information on the server and type data are transferred. In addition, it services the broadcasting in real-time to clients which want to use them.

4.3 Designing Topographic Map Data

For digital map, which is one of the most necessary data contents at fields, national digital topographic map is defined in this study. Then, data is organized such that they are serviced through the data processing server. By organizing the national digital topographic map into 9 levels, the digital map is formed to be serviced. In addition, defined layers include general ground configurations such as roads, buildings and water systems. Moreover, in order to construct basic environments for searching positions and preparing control-point map of the topographic map, national lot numbers are managed as a database. It also includes general facility data for searching positions.

The national digital map to be serviced and used in the data processing server has a scale from 1:5000 to 1:1,600,000. According to the defined level, it searches the grid level file with coordinates and scale requested by clients. Then, digital topographic data corresponding to the searched area are serviced to clients in accordance with the protocol definition, designed for this study.

5. CLIENT APPLICATION FOR CONNECTION TEST

5.1 Reference Data Management System

The reference data management system is an application for managing reference data. It interactively communicates with the data processing server through the network so that current data related with the control-point can be managed. It is connected with the data processing server through the network. It has functions of input, modification, delete and search for the control-point, and can manage history data required at survey fields. Communication with the data processing server can be performed interactively in a systematic way by organizing data of designed protocol type as packets.

5.2 GPS-RTCM Data Processing System

The GPS-RTCM data processing system transfers GPS data received from the GPS receiver in real-time to the data processing server so that they can be managed in the database. RTCM has a variety of types according to a message type. However, message types of 18, 19 and 20 were organized to be skipped by self-filtering them. In addition, those data can be transferred to the data processing server in real-time.

6. CONCLUSIONS

In this study, developing a data service model is investigated in order to service survey data occurring at cadastral survey fields in real-time through the network. Therefore, data processing core module on the basis of powerful threads, technology for processing huge amount of data, and speed enhancement module for managing data in real-time are developed. The data processing server using them showed stable performance for various environments and requirements occurring at cadastral survey fields. In addition, a basic model, meeting requirements related with data processing at cadastral survey fields, is constructed.

Therefore, in this study, it is determined that various additional supports can be serviced by smoothly performing real-time data processing among survey fields, offices and central database. Accordingly, if data and service standardizations for cadastral survey data collected at fields are defined, the data integration and management with cadastral survey fields can be computerized and managed in an integrated way with ease.

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