BUILDING OF B/S-BASED OBJECT ORIENTED ELECTRONIC CHART DATABASE

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ABSTRACT

This paper researches in system architecture of Internet-based Electronic Chart, and mainly discusses how to establish object-oriented chart database, how to search useful spatial data from chart database.

1. INTRODUCTION

With the development of Internet, how to realize Electronic Chart application through INTERNET makes more attention than before. The rapid development of satellite communications provides an unprecedented chance to the development of communications between land and ship. Therefore, building IIS Electronic Chart Server and the related technologies become pop technologies in research of Electronic Chart. Web-Chart is the Electronic Chart that based on Browser/Server structure, and Web-Chart realizes the rapid display of vector graph and the seamless connection of dynamic data. Browsers download this system from server into client through INTERNET, and load graphic data, build database link. When user uses data and graph, it produces dynamic SQL language, and accesses database server through INTERNET, then user can operate vector graph and dynamic data.

Database Server's realization is based on file system and Database Management System (DBMS). It can satisfy request of accessing database, especially accessing the structure data. Application Server is commonly a server who can provide universal or professional function based on all sorts of application models or computing technology in professional field. It was built based on basic data management function of file and database, Web-chart, Site Server, WAP Gateway, and some other applications are all members of this application server category. They commonly need append function modules of different professional fields. For example, the web application need user to convey computing result to web server with HTTP protocol, and make farther respond in web server. These functions commonly were realized by system's Remote Procession Call (RPC) or service progress. They provide functional modules to interact with exterior and coordinate interior. Intelligent information agent acts as this kind of functional module.

Web server is the core part of building of a web computing platform. It provides many service functions supported by file server, database server and application server. Its main aim is to realize the connect interface of application service functions and the call of HTTP.

Client is the front end to users access and process all sorts of web service functions. It can realize many interactive functions to users, and make these interactive functions to communicate with HTTP protocol and web server. Commonly, client use directly HTML language or Java Script/VB Script, but it will need ActiveX control or Plug-in to deal with sophisticated computing to satisfy the need of client function. In Web-GIS, we should satisfy the distributed computing function. For this sophisticated function, we use ActiveX or Plug-in to realize it.

Web-Chart can conveniently operate vector graph, such as zoom out, zoom in, roam, pan and some other basic function. Web-Chart also has some other merits:

1) The broader browse ability: Internet makes user can browse the newest data from multi-server in different place simultaneously. This feature facilitates the management of Electronic Chart Data, makes management and combination of distributed multi-data source become easier to achieve.
2) Platform independent: Don't care what kind of machine the server or client is, and what kind of chart software the Web-chart server use, through Web browser, user can browse Web-chart data transparently, dynamically assemble distributed components and manage and analyze spatial data cooperatively, to achieve the sharing of remote heterogeneous data in spite of hardware and software. To achieve platform independent, it is the key technology to build the object-oriented ECDB.

2. BUILDING OF OBJECT ORIENTED ELECTRONIC CHART DATABASE

Using object-oriented technology, we can extract information from geographic object in Electronic Chart to create different class, build the relations among them, and encapsulate attributes and operations of classes. Using object-oriented data model, we can define three-dimension spatial data model, spatial-temporal data model and some other models and build the Internet-based distributed spatial data model. Object-oriented technology is based on object in concept. It combines the similar objects as different classes. By generalizing the object class, we can create hyper-class, these object classes were named sub-class. Sub-class can inherit the method and attribute of hyper-class. Object-oriented technology also provides the approach to extract data, that is to say the generalization and aggregation of objects or classes. We can build the hierarchy of objects by using generalization and aggregation repeatedly to extract data. There is the one-multi relation between every object and its member. Object-oriented data extraction technology provides the computing ability in lengthways spatial relations and realize the object's classing, unit, generalization, aggregation and class's

inheritance, encapsulation, congregation, etc.

Objected oriented geographic database need maintain the integrality and consistency of storage and expression. For example, a route has only one geometrical identification and one geographic identification. The data organization of geographic data includes organization and management of spatial data, attribute data, image data, etc. The key technology of data organization is to express and store spatial data and attribute data integration.

1) spatial objects mainly divided into five categories:

- Point: It includes single point (e.g. buoy, navigation mark, etc.), vector point (e.g. beacon), etc.
- Line: Line is interconnected points or arcs, they may netlike, but must interconnected, such as fiber cable, etc.
- Region: Region was made up of one or many closed and disjointed polygons and rings, it can include multi-island. For Example, anchorage ground, restricted navigation zone are all region.
- Complicated object: The object was made up of two or more basic objects (point, line, region) or other complicated objects. For example, school can act as a complicated object,. It includes roads, houses, water tower and some other basic geographic elements.
- Annotate: Annotate is used to describe place name, features of geographic objects, etc. Because the model need all terrain features should be stored integration, each integrated terrain feature only has single geometric object identification no matter how big the terrain feature is. The spatial data of terrain feature should be stored integration. But the segregation of integration of terrain features should depend the requests of users and applications completely.

2) Attributes: Attributes of all spatial object should be managed in project unitedly by RDBMS. Attribute data were stored in tables of RDBMS. Referring to standard objects, users classify them unitedly, and appoint single classification code (identification) of terrain features. For example, we classify them into control point, road, habitation, water system, vegetation, etc. in different tiers. Any integrated terrain feature only corresponds to one record of attribute data. Single object identification (OID) connects spatial object and the corresponding attribute record, which was described in figure 1. In order to organize and express spatial geographic objects efficiently, we extract objects hierarchically according to the size of geographic objects, and arrange, delaminate and build spatial index for these objects.

The system architecture of object oriented chart database. The B/S map database is the production of combination of database technology and computer network technology. It is a computer system to manage distributed map database. A distributed map database is a set that was composed by many logic related databases distributed in network. Each node of this network has independent processing ability to implement local application. At the same time, each node can implement global application through network system. Map database server is mainly used to manage SQL requests from clients, and return results to clients. In practice, database server achieves all data operations, spatial data organizations, concurrency control, security auditing, and system management in C/S database. Client mainly presides send user's SQL requests to server, and processes and expresses the results. In a typical application structure, client usually deals with the application's expressive logic. B/S map database is an organic association of member map database located in nodes of network. The management of this association is B/S map database system.

Electronic Chart evolved from file-based application to spatial geographic extended RDBMS, and aim to a integrated object relational system. Therefore, we can use spatial geographic technology to process file, time series data, image and audio, and some other standard, abstract data type seamlessly. The problem, which must be resolved by RDBMS, can use more direct and accurate approach (e.g. SQL) to resolve.

Traditionally, there are two kinds of spatial data index: The first is to build a spatial index out of the server and stored in BLOB, and you can use it or search BLOB when you use it. However, no matter how fine this index's structure is, the maintenance and searching include external parts, which will lead to more I/O overhead and coexist problem, to make system slower and inefficient. Second method is spatial segmentation. This method divides data into cells according to stated grid and other layered architecture (e.g. quad tree). Each cell was assigned a number, and each spatial object relates to the number of the same cell. But space is not in linear order. The irregularity of many spatial features needs intricate searching and the check for many potential errors. It's also a slower and inefficient method.

Comparing to the methods we discuss above, R-tree is a high-powered, multidimensional access approach. This approach is built in kernel of database and cooperates with extensional data type to manage spatial geographic data properly. Being different from standard index. R-tree does not divide the space into integrated overlay made up of non-overlap and adjoining cells. Adversely, it automatically represents each object with "side box" that is decided by spatial figure. These "side box" may overlap, and do not fill all space. We should not know the spatial dimension of data in advance.

A spatial data engine (SDE) layer or data class is geographic feature classes that have the same attribute class. In order to search conveniently, SDE uses DBMS attribute column index. SDE index all features in a layer, to realize rapid spatial searching, and provides high-powered searching for oversize database. The unique function of spatial index is to provide special two dimensions index of spatial features, and to realize a logical and nonphysical hierarchy. The efficient supporting of geographic data not only needs point, line and region objects, but also needs a set of steady spatial object models that can express their features clearly. SDE can describe linear features, for instance, an uncrossed road, a road crossed at termination, a self-crossed rode, and multi-roads that crossed at end-point to form a network. Similarly, we can describe region features by single polygon, hollow polygon, and poly-polygons.

Attribute also cannot be directly indexed into regional piece object, but indexed into a concrete place in this regional piece. Due to each accessing of polygons need be included into reconstruction of multi-accessing, the feature we talk above may become a default. The spatial object model of SDE stores each regional piece into an integrated polygon. Thus, we can find entire object by only one accessing.

In SDE, geographic features include spatial objects (e.g. point, line or region) and relevant attributes described by these objects. In RDBMS, data were stored in the tables made up of rows and columns. The crossed cell of row and column names field, and the data stored in field names value. Row represents a specific event, distance or geographic feature, and column includes the attribute of this feature. There are many types in attributes, which make geographic features become a value type stored in a column. SQL provides a interface of rational table, which enable user can select rows according to the number in the field. SQL statement is very flexible to program any basic query request.

Through the key, user can query the required data from tables. A key (it may be made up of one or more columns) represents the table uniquely. A column or several columns can be copied to another table, named external key. Main key and external key link two tables together, which can reduce the redundancy of the database. This technology is called database standardization. We can satisfy the request and return the accurate geographic data through adding more tables and using the relations among main keys and external keys. The query results are a series of rows that satisfy the corresponding SQL statements. These SQL statements are called cursor. The application can index large numbers of active cursors, and query every independent row from a cursor.

In object oriented DBMS, SDE can make IDS store and manage complicated geographic data. SDE does not change existing database or affect current application. It only adds a "Shape" column into existing table, and provides software to manage and access geometrical features of this column. SDE use R-tree to

store and access spatial data. The establishment and maintenance of spatial objects and spatial index table are automatic and transparent to users. Using spatial index table, user can query data and accumulate table as before, and also can write query to return spatial feature, or use spatial feature in request.

SDE provides a series of steady geometrical and spatial analytical functions. These functions decide the relationships of different geographic features, for example, if they are intersected, if they share a point or boundary, if they share a region, or if one object contains another object. Furthermore, SDE can also support some other spatial functions, such as cut, buffer generalization, distance computing and polygon overlap, etc.

3. CONCLUSION

With the development of INTERNET, establishing electronic chart on the web and building electronic chart website become more

impending than before. The building of Web-database of Electronic Chart involves many new technologies in GIS, computer technology, ocean transportation, etc. Researching in these technologies will promote the development of ocean transportation information

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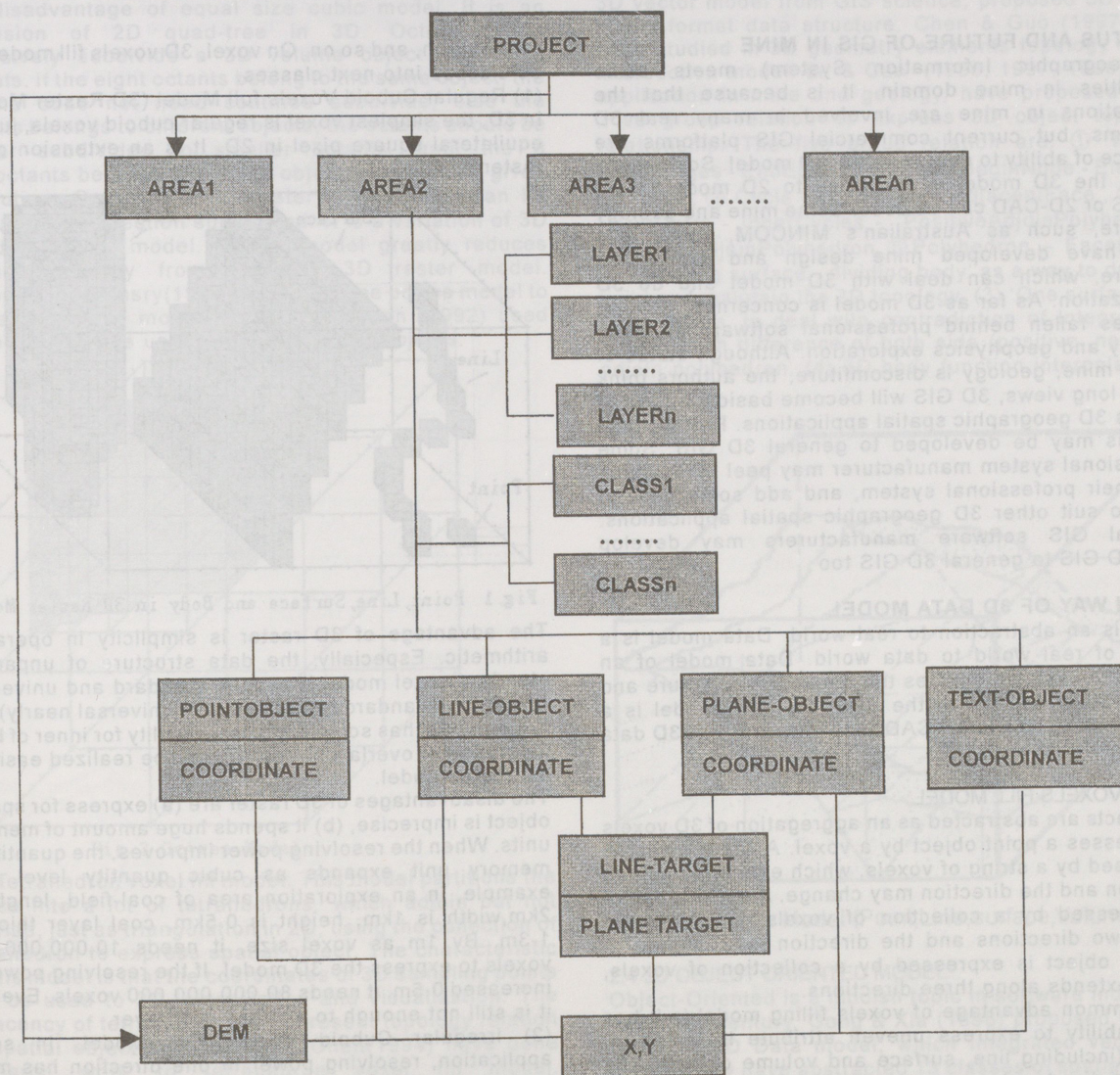

Figure1   Object Oriented Electronic Chart Database Architecture