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OBJECT TECHNOLOGY IN GPS/GIS

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Abstract:

Object Technology has been widely used in Globe Positioning Systems and Geographical Information Systems. This article discussed the Object-Oriented ideas in analysis and design of the GPS/GIS applications and the recent trends of the Object Technology development.

Keywords:

Object-Oriented, component, Distributed system, CORBA, DCOM

Introduction:

Since Object technology came into prominence a decade ago, products have predicted its success. In every area of software technology, Object-Oriented ideas are at the fore; this is true in programming languages, analysis and design methodology, and in databases, graphics, networks, distributed computation and even web applications. During the development of GPS/GIS, Object Technology also plays an active role especially when dealing with complex systems.

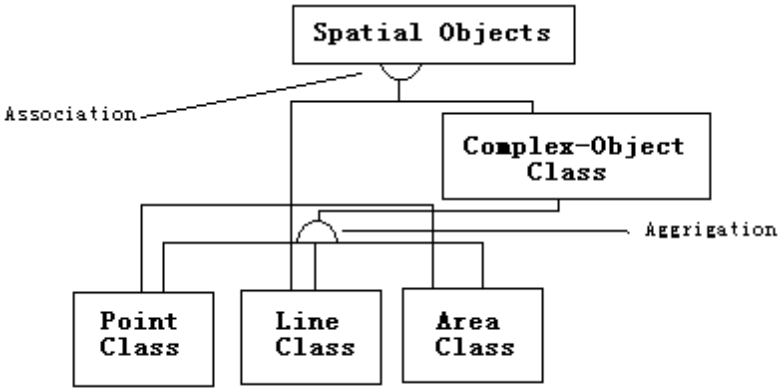
1.Object-Oriented Modeling Technique (OMT)

The core of GPS/GIS is spatial information. As an application of Information Science in geography, GPS/GIS development should be directed by the research of spatial information.

There are three kinds of abstract data types of the spatial information: point types, line types and area types. These types are called the basic spatial data types. However, instead of belonging to a simple basic data type, the complex geographical objects, which exists in the reality, are often the mixture of these three basic types and other smaller complex objects.

Traditional relational data model, which lacks of object identity and information sharing functions, is not suitable for dealing with the complex structure and relationship of geographical objects. To describe such multi-layer geographical information, Object Modeling Technique (OMT) is most useful.

OMT has provided four kinds of data modeling methods: Classification, Generalization, Association and Aggregation. Classification means to conclude the entities in reality into classes, Generalization means to conclude the classes into super-class. Association means to combines a set of familiar objects into a more advanced set-object and it represents the relationship of “member-of”. Aggregation means to combines a set of different objects to form a more complex composed-object, it represents the relationship of “part-of”. In GPS/GIS modeling, association and aggregation are often the most powerful tools in describing the complex systems. The following figure shows a simple model for GIS.



Using Object-Oriented Modeling Technique, we can build an independent object architecture. Because of the smoothness between Object-Oriented Analysis and Object-Oriented Design, such conceptual schema is easy to be implemented, and the application can be easily transplanted between different platforms, too. Furthermore, this kind of architecture is proved to be flexible. During the maintaining period of such architecture, you can extend the architecture's functions freely and clearly. OMT makes the whole geographical system simple.

2.Component Based Development (CBD)

Along with the wide applying of GPS/GIS technology, there is also a growing demand for new and more complex systems. Many system developer have found current design and development technique to be insufficient. So, software engineers are turning to Component Based Development(CBD). This strategy uses tested software component and to eliminate redesigning and redeveloping the same software features repeatedly. CBD lets developers reuse code that is written in any language and that runs on any platform.

According to the predict of a market research form, the Gartener Group, revenue from the sales of component-ware software will increase more than double before 2001. However, until now, there are still few off-the-shelf components for GPS/GIS application. MapInfo, an excellent GIS software, is a good example of Component-ware software. You can link, embed a MapInfo object into your document, post it to the web, or you can reuse it in your own Application. But as a commercial software, MapInfo's components did not expose all the interface of the components.

The GPS lab's Intelligent Vehicle Monitoring System (IVMS) is totally based on reusable components. Using Delphi, we have developed the network components to implement the Client/Server architecture, the graphic components to visualize the geographical information, the interface components to deal with the user's interaction. Each component has its own properties and methods to expose its interface, and the message mechanism to communicate with other components. Based on these effective components, IVMS was developed into a robust, flexible fast application.

3.Distributed GPS/GIS System based on Object Technique

The rapid development of computer network has brought us into a fresh world. More and more applications are being migrated to WWW, which also includes the GPS/GISs.

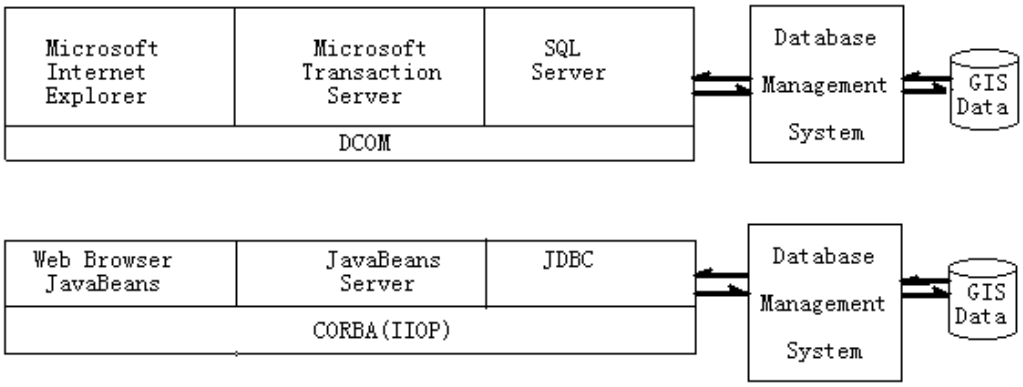
Query and analysis lie at the heart of a GIS, The web's heterogeneous enviroment requires that query mechanisms are both software- and hardware- neutral. This create a need for spatial query mechanism that are distributed and open. In a distributed geographic information system,

GIS data, including both geograhic and attribute data, can be physical separated, possibly residing in deferent database management systems on different machines.

To realize such system, there are two communication mechanisms: CORBA and DCOM.

CORBA, means the Common Object Request Broker Architecture, is a specification for creating, distributing, and managing distributed ,programmed objects across a network. The Object Request Broker(ORB) is an essential concept in CORBA. Given a network of clients and servers on different machines, ORB support means that a client program, which is treated as a object, can request services from a server program or object without having to understand where the server is or what the interface to the server actually is. General Inter-ORB Protocol is implemented to provide such support. When a client makes a spatial query for geographic information to a server in the network, it must have an address for the server. In CORBA, this address is known as the Inter-operable Reference (IOR), Using GIOP, part of the address is based on the server's port number and IP address. In the client computer, a table can be created to map IORs to proxy names. The GIOP lets the program connect with an IOR and then send request to it, when apporiate, server send replies.

Another competing vision of distributed object model comes from Microsoft's Distributed Component Object Model (DCOM). DCOM components use an interface definition language (IDL) to specify the properties, methods and events of the distributed objects. Comparing with Sun's Java-beans, which is based on CORBA, DCOM is independent of language but dependant of platform. The two kinds of architectures are shown as the following:



The Object Management Group (OMG) has played a leading role in establishing open system for distributed object computing. Internet OMG standard is emerging. Before long, the GIS will be much more active in Internet/Intranet and geographical information can be delivered to people's desks over corporate internet or intranets without concern for hardware platform. On the other hand, distributed GPS applications will be easier to establish, and remote monitoring and controls based on GPS will soon be world wide.

Conclusion:

Object Technology is not a matter of fashion. It's simply that no one really learns how to tackle the kind of sophisticated systems that our users now want without using Object Technology. In the future, areas that had traditionally resisted the influx of Object-Oriented ideas are no longer immune. With the increasing demand of GPS/GIS applications, today, system developers should face the challenge of mastering the Object Technology.

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