GEOD2X: A FLEXIBLE SOLUTION FOR GIS DATA EXCHANGE BASED ON COM

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ABSTRACT

This paper introduces our experiences of developing a flexible solution for GIS data exchange system based on COM. A series of ActiveX Controls were developed for assembling various data exchange applications among GIsSs. Our experiences verified that COM/DCOM model is a flexible and economic solution for GIS data exchange.

1. BACKGROUND

Data preparation is one of the hardest tasks in making a GIS practicable. It is estimated that more than 80 percentages of a GIS project is collecting, coordinating, inspecting and input data into the GIS database. Generally, commercial GIS software packages provide menu items to fulfill data exchange between various data formats. But these menu items often fail to meet the needs of various end users of GIS software. There are several causes prevent the success of import and export data from GIS to GIS or other graphic systems.

- The data models are not identical between GIsSs or GIS and other graphic systems. A typical example is the data model of CAD, which is severely different from that of usual GIS. Many entities in CAD have no counterparts in GIS.
- The user’s need for GIS varies from one user to another. Urban planning department has its own convention that is thoroughly different from that of surveying and mapping department. An inflexible solution can not meet these two kinds of different need simultaneously.
- GIS solution providers also try to overcome these problems. They provide many options for end user in the data exchange menu items. These options in a certain extend offer variable solution for end users, but it is far from all needs of end users.
- For GIS solution providers, another effort is made the data standard. The OpenGIS consortium is an example. Theoretically it is not difficult to abide by the OpenGIS specification, but it is not rational to require a GIS constructor to have all its data sets follow the OpenGIS specification, especially those historically accumulated data.
- For GIS software developer, another puzzle is to keep pace of the upgrading step of other graphic systems and their data formats.

To solve all above problems, COM is an economic and flexible solution. Our successful experience verified this selection.

2. COM/DCOM MODEL OF ActiveX TECHNIQUE

With the achievement of computer software engineering, the component technique is promptly applied to design GIS. Component GIS is designed to base itself on a series of standard components. Some of these components are imported from commercial providers. Others are developed specially for spatial information. The most important feature of these components is the flexibility of being rearranged into customized system. Visual and standard interface makes these customizations an easy and convenient building block to construct a new system for end users.

Currently there are two mainstream models for developing component system among them, OLE is Microsoft Component Object Model (COM) and Distributed COM (DCOM). Another is OMG’s Common Object Request Broker Architecture (CORBA). Microsoft’s power position makes COM/DCOM the more popular model to develop components. Incorporating the spreading of COM/DCOM model, Microsoft released the ActiveX technique and a series of supporting tools for designing, coding, debugging and testing ActiveX components. ActiveX component is in practice the most wide-adapted standard component for visual programming. In the present stage, Component GISs are mostly ActiveX components or its predecessor OLE components. This paper will introduce our experiences of developing a series of ActiveX components for GIS data exchanging.

ActiveX is a set of open techniques based on COM/DCOM. It stands for a strategy of integrating application system and Internet. No matter what language is utilized to develop an ActiveX component, components abiding by this standard support interoperation in PC or distributed environment.

There are three types of ActiveX component for common use. They are Control, automation Server and Document. As a reusable component, ActiveX Control appears an encapsulated code block. It provides Attributes (member variables), Functions and Events for communication with other programs. ActiveX Control is also a special OLE Control. It can be used not only in container that supports OLE, but also as an Internet Control to become part of web pages. ActiveX Control can be developed in various language environments such as VB, VC etc. ActiveX Control can be imported to various language environments, such as VB, VC, Delphi, PB, VF etc., to incorporate the development of application systems.

In this paper, VC++ is chosen to develop ActiveX Controls and VB is chosen to test these ActiveX Controls with an experimental system. Experiments of these components called by Delphi and PB was also conducted with satisfactory results.

3. DESIGN OF DATA EXCHANGE COMPONENTS FOR GIS

Among GIS users, there are about ten data formats frequently used. Some famous of them are DWG, DXF, MIF, Coverage, SHAPE etc. Traditionally, to provide a total solution for data exchange among them, it is required to work out an executable program for each pair of them. Designed by ActiveX technique, what we have to do is to work out a series of ActiveX Controls and customize them to final applications.

In our experiments, one component is designed for each type of data format. For example, an ActiveX Control GeoDXF is developed for dxf format and so is an ActiveX Control GeoVCT for China’s standard spatial data exchange format VCT. Each of
these components has at least two types of functions. One is for input and another for output. The number of these functions varies from format to format according to its geometric model. For example, the VCT format defines only three types of geometric objects. The ActiveX Control GeoVCT provides only three functions for input point, line and polygon respectively and three functions for output the same three types of geometric type.

In order to translate non-geometric information of geometric objects, we designed another component called GeoExchangeCenter to incorporate the exchange of non-geometric information in the process. This component manages a dictionary which contains all the information needed for original object being transformed to new object. For example, if both the DXF layers Provincial Road and National Road are required to transform to a new feature class High Road in VCT format, this component will have an instance contains two dictionary items. One is Provincial Road to High Road and another is National Road to High Road. For another example, if there are two dictionary items: Feature Point to Label Point and Feature Point to Feature Point, the DXF layer Feature Point will be transformed into two feature classes, namely Label Point and Feature Point. Fig.1 shows the logical relationship among all these components.

As a component, it has also message processing functions to response external events such as mouse-down and mouse-up. In order to reach the maximum flexibility, these data exchange components are designed without visual interface. The application program that refers to these components should provide the end-user's interface on request.

5. EXAMPLES

In VC++6.0, we have developed a series of ActiveX Controls including GeoDXF, GeoVCT, GeoFile, GeoFile, GeoSHAPE. GeoFile is for reading data from and writing data to GeoStar File format. Other ActiveX Controls are for reading and writing of data format of what their names imply.

Fig.2 A Dwg data view of sample data set

Making use of these ActiveX Controls, we implemented several application systems for data transformation in VB6.0. Fig.2 and Fig.3 show an example of sample data of DWG format transformed to GeoStar file format. Usually we develop this kind of application system on end-user's demands directly based on ActiveX Controls needed. Or we release these ActiveX Controls and the end-user develops his own system by using these ActiveX Controls needed.

Fig.3 The GeoStar data view of sample data set transformed from Dwg

6. CONCLUSIONS

Data preparation is a hard task in making a GIS working effectively. Especially during the start phase of constructing a GIS, most of the work is to collect data and input them in the database. A flexible data transformation program is of significant importance. COM and its ActiveX technique provide an
economic and effective solution for both the system developer and end-user.

By ActiveX technique, the system developer has a flexible way to provide their production. They develop ActiveX Controls and assemble application systems in need. For GIS data exchange, there is another more important advantage. In GIS data exchange, the difficulty lies in model interpretation. All users have their own interpretation. Solution provider of ActiveX structure reserves this interpretation to the end-user or the customization of these ActiveX Controls.

By ActiveX technique, we also benefit from the simplicity of code maintenance. ActiveX supports object-oriented technique and provides a mechanism of upgrading easily. For example, while the AutoCAD was upgrading from Version 12.0 to Version 14.0, we can promptly upgrade the ActiveX Control GeoDxf and GeoDwg by simply upgrading the previous methods or adding new methods. The old version end-users ActiveX Control GeoDxf and GeoDwg can be upgraded via Internet. This upgrading does not affect the proper running of customized application, meanwhile the customized application system can add new function during to the upgrading of its referred ActiveX Controls.

In one word, component is the most significant trend of software engineering. Its reusability provides a totally new way to develop economic systems. This technique also breaks the traditional way of developing software. Small companies or even a single person can have chances to join the software market competition. GIS industry will also inevitably be affected by this trend. Our experience of using ActiveX Control to develop GIS module partially confirmed this conclusion.

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