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Secondary Development of Database and Information System of Road Engineering

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Abstract: Information management of road's elementary data will play a more important role for accident treatment, disaster relief, data management, engineering construction and others. In this study, we use the MapX and VB programs, the database of road property is designed and the methods of data's input, edit and building of Geoset object are all analyzed. The functional modules, including file management, view operation, select query, object editor, are established and the embedded procedures are all analyzed, too. Based on this, the information system are developed which can realize the information management of road basic data.

Key words: Road, information system, secondary development

INTRODUCTION

Geographic Information Systems (Zhang *et al*., 1999; Zhu and Li, 2004) (GIS) is based on the geographic spatial database and it achieves the goals of data collection, data management, data operation, data analysis, data simulation and data indication. After 40 years of development, GIS is widely used in many fields, such as analysis of geological disasters, traffic management, city planning, infrastructure construction of road traffic and resource management, e.g., land resource, mineral resource and water resource and so on.

The secondary development modes of GIS include three methods (Zhang *et al*., 1999; Zhu and Li, 2004), they are: (1) Independent development. If one wants to use this method, the all algorithms have to be designed by him without the help of existing tools of GIS. (2) Simple secondary development. This method uses the development languages based on the advanced GIS tool to develop the new system to realize the development goal. (3) Integrated development. Using this method, the GIS controls need to be embedded to the user program to achieve the system's purpose and function in the visual development environment, such as VB, VC and Delphi, etc.

In recent years, many authors have developed the related systems using the mode of integrated development. Zhu *et al*. (2003) analyzed the design and development method of the spatial system of groundwater resources, Jin *et al*. (2011) discuss the secondary development of the basic function of GIS's utility software based on MapX controls, Li *et al*. (2002) developed the management system of marine functional zoning, Li and Guo (2004) analyzed the concrete achieve method of map-data relax coupling manner in Mapgis second designing, Liao *et al*. (2011) studied the safety assessment of highway using GIS technology and Wang and Liu (2003) established the road's geological hazards information management and decision making support system.

With the development of road construction in China, the traditional method of basic data management of road engineering is at best inconvenient. So, it is very important to establish the data and file management systems of basic file of road engineering. In recent years, some provinces and cities in China have used the GIS technology in road engineering (Wu *et al*., 2009; Zhao *et al*., 2005; Jia *et al*., 2002), such as route selection, design of section and mass calculation, highway management, road maintenance and so forth and these achieved good results. In this study, based on the programs MapX and VB (Zhang and Huang, 2004; Zhou and Wang, 2008; Liu, 2003), we use the integrated development mode to develop the information management system of road and it can realize the goal of information management of it.

DATABASE CONSTRUCTION OF ROAD ENGINEERING

Structure design of database: In the system, according to the graphic data of the road route and property data of describing road information, the management function of graphic data of MapX (Zhang *et al*., 1999; Zhu and

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Li, 2004) is used to manage the graphic database and the designed layers include line section, bridge, tunnel and slope. The property data describes the management information of road engineering and in this system, the property database includes the information tables of line section, bridge, tunnel and slope. The information table of line section includes the following information, such as the name of line section, pile number, construction organization, construction time and reinforcement method. The information table of tunnel has the information including the name of tunnel, pile number, builder, construction methods and reinforcement methods. The information table of bridge includes the name of bridge, pile number, builder, construction time, construction methods and bridge type and the information table of slope has the contents include the name of slope, pile number, construction organization, construction time, construction methods and reinforcement methods. In this system, the data processing is shown as Fig. 1.

Data input and edit: The property data either can be input into the property table of MapInfo or be saved in the database (Zhu *et al*., 2003; Jin *et al*., 2011). In this system, the property data is managed by the property table of MapInfo and the property information of every metafile is input into the property table of MapInfo after the map is digitized. In some cases, of course, the database management has to be chosen if the existing mode of property data is one database or the property information of metafile can not be managed by MapInfo. Here, taking slope as an example, the data input and edit is shown as Fig. 2.

Creation of geoset object: Because the data inputted by MapInfo can not be used directly (Li *et al*., 2002; Li and Guo, 2004), the file name extension which is.gst need be generated. The creation processes of Geoset object are: (1) Data storage. It is best to copy the map data to the installation directory of MapX or to create a new

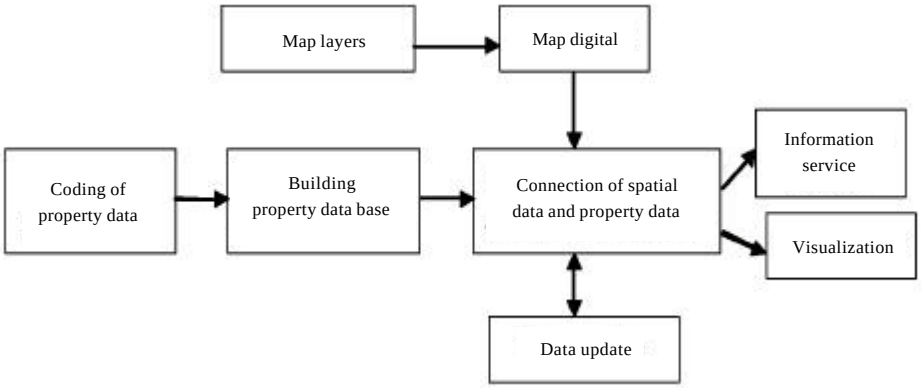

Fig. 1: Data processing

Fig. 2: Data input and edit

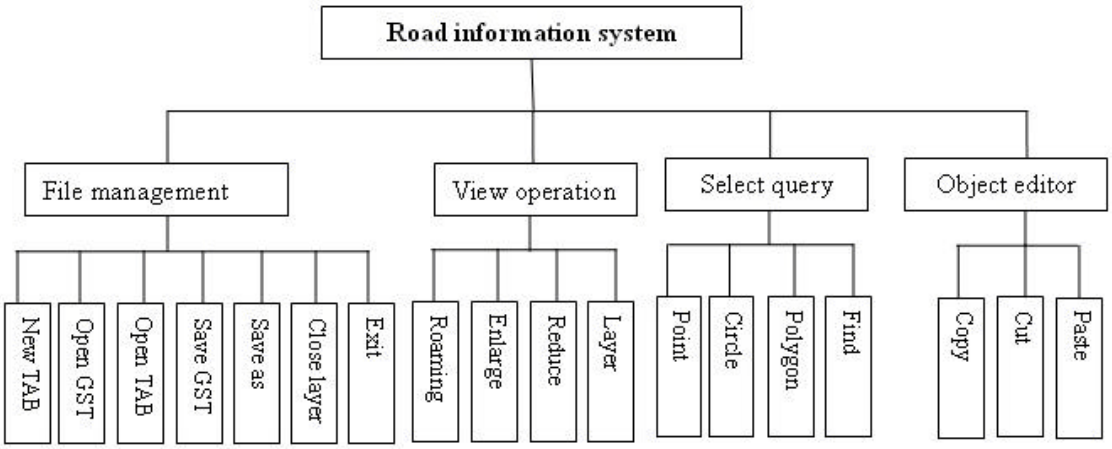

Fig. 3: System configuration

subdirectory to save it. Of course, you can save it in other directory but you have to setup the map data in the same directory when you publish the application program, or, if not, the map data can not be found. (2) Creation of the.gst file and the map setting. Opens the Geoset Manager program and adds the new gst file to the map layer and then sets the map data including layer order, indication range, visual range of every layer and the map center and so on. When the map data set have been finished, it is best to be saved in the subdirectory Maps.

DESIGN OF THE ROAD INFORMATION SYSTEM

Functional configuration: This system uses the modular configuration (Zhang *et al*., 1999; Zhu and Li, 2004) and the modules include file management, view operation, select query and object edit. The configuration of the system is shown as Fig. 3.

Modules embedded

Map integrated and embedded: Because the primary electronic map which saved as layers (Bai, 2009; Du *et al*., 2005; Qi *et al*., 2003), have been developed using MapInfo, the layers have to be integrated to create the. gst file which can be used in MpaX. The Geoset Manager of MapX is used to integrate files and the processes are: (1) Open the layer control, (2) Load the layers and adjust their sequence (shown as Fig. 4), (3) Save the gc.gst file to the created directory (shown as Fig. 5). In Fig. 5, we only give the sketch map and in this picture, the black points are bridges, the green points are slopes and the red points are tunnels.

Design of the view operation: The toolbar and shortcut menu are all be used to design the functional module of view operation. The toolbar includes many functions, such as roaming, enlarge, reduce, layer control, selection and inquiry tool and so on. The design processes are: (1) Add the map to ImageList, (2) Create Button object in the toolbar control, (3) Write the program about ButtonClick. The program code (Bai, 2009; Du *et al*., 2005; Qi *et al*., 2003) is shown as following.

```
Private Sub Toolbar_ButtonClick (ByVal Button As
MSComctlLib.Button)

• mnuSelectI.Checked = False
• Select Case Button.Index

Case 1:  mnuFileAddTAB_Click
Case 2:  mnuFileOpenGST_Click
Case 3:  mnuFileSaveas_Click
Case 4:  mnuViewPan_Click
Case 5:  mnuViewZoomIn_Click
Case 6:  mnuViewZoomOut_Click
Case 7:  mnuZoomtoLayer_Click
Case 8:  mnuViewLayerCtrl_Click
Case 9:  mnuSelectI_Click
Case 10: mnuSelectbyPoint_Click
Case 11: mnuSelectbyMaquee_Click
Case 12: mnuSelectbyCircle_Click
Case 13: mnuSelectbyPolygon_Click
End Select
End Sub
```

Layer controlling: The user can get the information of any layer by means of map or layers controlling but it is often difficult if there are a large number of layers. In this system, we use the layer control function of MapX to control all layers. The program code (Bai, 2009; Du *et al*., 2005; Qi *et al*., 2003) is following.

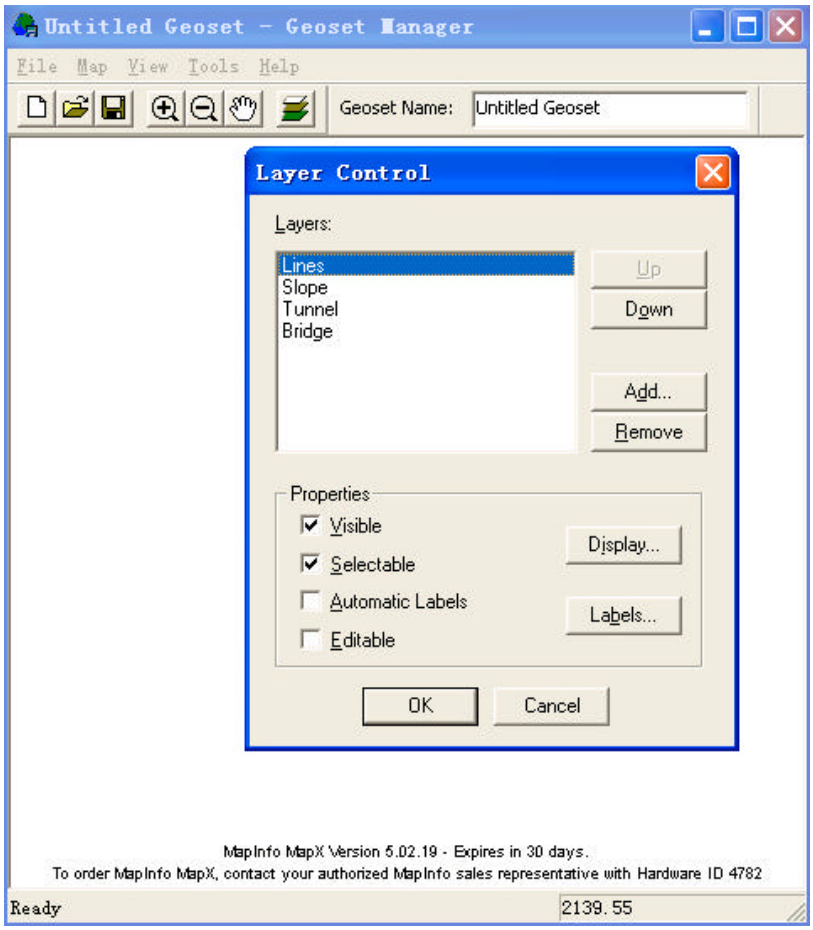

Fig. 4: Layers loading

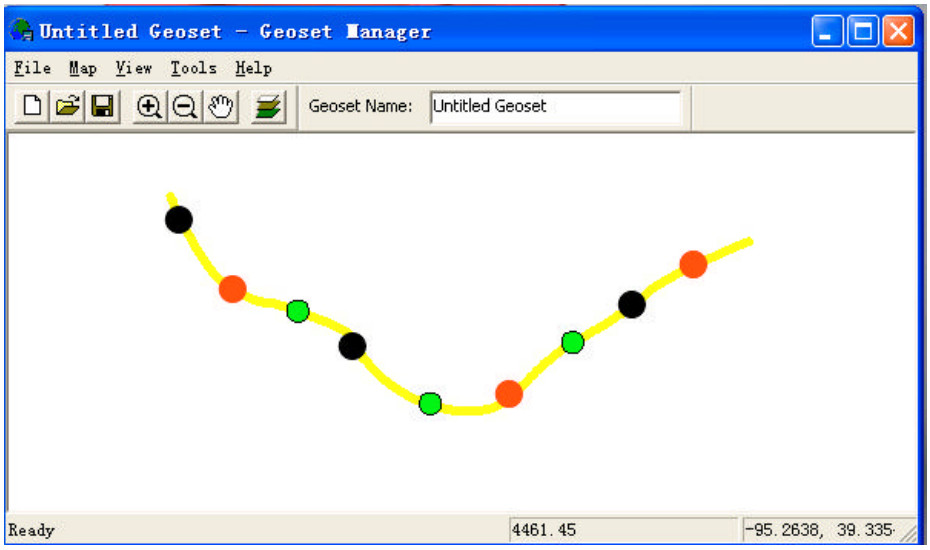

Fig. 5: gc.gst file

- Private Sub Form_Load()
- m_iSnapTolerance = 5
- m_bIQuery = False
- StatusBar.Panels(1).Width = StatusBar. Width
- StatusBar.Panels(1).Text = "No loaded map"
- Map1. Left = 0
- Map1. Width = frmMain.Width
- Map1. Height = Frame1.Top
- Map1. Top = Toolbar.Top+Toolbar. Height
- cbLayers. Left = Toolbar. Buttons (Toolbar. Buttons. Count-1). Left+Toolbar. Buttons (Toolbar. Buttons. Count- 1). Width+Toolbar. ButtonWidth
- cbLayers.Top = Toolbar.Top+(Toolbar. Height-cbLayers.Height)/2+15
- Dim temp As Integer
- temp = frmMain.Left+frmMain.Width
- Frame1.Width = Frame1. Left+temp
- Map1. CreateCustomTool 199, miTool TypePoint, 2

End Sub

CONCLUSION

In this study, we discuss the property database of road engineering and analyz the methods of data input, data edit and establishment of Geoset object and write the program code to develop the road information system. This system can be used to manage the basic data and files of road engineering. Of course, in this study, we only give some modules' program code and the system is primary which need be further improved.

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