A VIDEO GEOGRAPHIC INFORMATION SYSTEM FOR SUPPORTING BI-DIRECTIONAL SEARCH FOR VIDEO DATA AND GEOGRAPHIC INFORMATION

JAEJUN YOO, IN-HAK JOO, JONG-HUYN PARK, JONG-HUN LEE
GIS Research Team, Spatial & Image Information Technology Center
ETRI - Computer & Software Technology Laboratory

161 Kajong-Dong, Yusung, Taejon, 305-350, KOREA
TEL/FAX : +82-42-860-5529 / +82-42-860-4844
E-mail : {jjryu, ihjoo, jhp, jong}@etri.re.kr

ABSTRACT

Recently, as the geographic information system (GIS) which searches, manages geographic information is used more widely, there is more requests for some systems which can search and display more actual and realistic information. As a response to these requests, the video geographic information system which connects video data obtained by using cameras and geographic information as it is by displaying the obtained video data is being more popular.

However, because most existing video geographic information systems consider video data as an attribute of geographic information or use simple one-way links from geographic information to video data to connect video data with geographic information, they support only displaying video data through searching geographic information.

In this paper, we design and implement a video geographic information system which connects video data with geographic information and supports bi-directional search; searching geographic information through searching video data and searching video data through searching geographic information. To do this, we 1) propose an ER data model to represent connection information related to video data, geographic information, 2) propose a process to extract and to construct connection information from video data and geographic information, 3) show a component based system architecture to organize the video geographic information system.

Keywords : Geographic Information System, GIS, Video GIS

1. Introduction

Recently, as the geographic information system (GIS) which manages, analyzes, processes geographic information is used more widely in public, there is more requests for some systems which can support realistic and actual additional information and manage

geographic information with the realities [2]. As a response to these requests, the video geographic information systems which support obtained video data related to specific geographic information have appeared and are being more popular [4]. By using these systems, we can get actual scenes or visual attributes of geographic objects or geographic information appearing in video data. Most existing video geographic information systems consider video data as an attribute of geographic information or use one-way link from geographic information to video data to connect video data with geographic information. This method can't support displaying and searching geographic information through searching video data; searching geographic objects appearing in video/image data.

In this paper, we design and implement a video geographic information system which supports bi-directional search of geographic information and video data. To implement such a system, we propose an ER data model to represent connection information related to video data, and geographic information, and propose a process to extract and to construct connection information from video data and geographic information. We design the system using component based architecture and object-oriented concept.

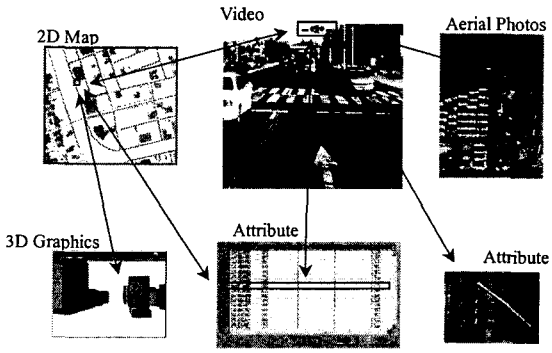
The rest of this paper is structured as follows. In section 2 we explain the concept of the video geographic information systems and introduce some examples of implemented systems as related works. In section 3 we present main components which constitute the designed video geographic information system in this paper. In section 4 we show the design and implementation of a video geographic information. In section 5 we conclude the paper.

2. Related Works

2.1 Connection of Video Data and Geographic Information

To connecting video data with geographic information means to link geographic information with the video data about the region in which the video data are obtained. To do this, several technologies, such as 2D/3D graphics, video/image measuring technology, and video/image processing technologies, are required.

By connecting video/image data and 2D/3D geographic information, we can use this visual



[Figure 1] Connection of Video, Image and Geographic Information

information in some applications, such as facility management applications and disaster prevention systems, which require more accurate visual information of geographic information.

2.2 Examples of Implemented Systems

■ **MediaMapper**

MediaMapper™[6] is a software which operates on desktop PC environment and is developed by Red Hen Systems. MediaMapper™ supports displaying video/image data through searching geographic information, but not displaying geographic information through searching video/image data.

■ **Iwane Video GIS**

Iwane Video GIS[7] is a series of video geographic information systems developed by Iwane Corporation. This Video GIS software supports displaying video data through searching geographic information, but not displaying geographic information through searching video data; that is, searching geographic objects appearing in video data.

3. Introduction to Main Components

3.1 Map Component

A Map component is a component which can construct, display, edit, search, and manage 2D/3D geographic information which is equivalent to map data.

The designed system in this paper uses MapBase Edit[1] component as a map component. MapBase Edit component was developed and implemented through a research of "A study on development of open GIS component software" prosecuted in Electronics and Telecommunication Research Institute (ETRI) in Korea. MapBase Edit component supports the geometry standard of OGC (Open GIS Consortium).

3.2 Video Data Component

A video data component is a component which can display and manage video/image data.

The designed system in this paper uses GridViewer component as a video data component. GridViewer component was developed and implemented through a research in Electronics and Telecommunication Research Institute (ETRI) in Korea. The interface of GridViewer component is based on Grid Coverage [3] of OGC (Open GIS Consortium).

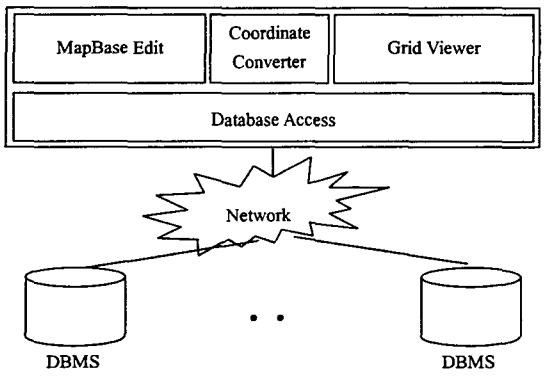
4. Design and Implementation of A Video Geographic Information System

4.1 System Architecture

The designed video geographic information system in this paper is structured in client/server architecture as figure 2 shows. The server part of the system is

composed of several databases which store video data, geographic information and connection information and the client part is composed of a map component, a coordinate converter component, a video data component, and a database access component.

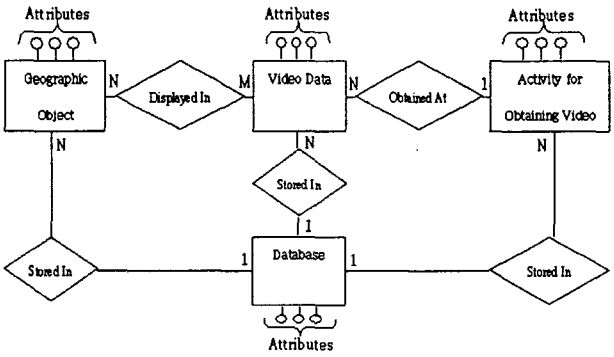
We use MapBase Edit component as a map component. A coordinate converter component is a component to convert coordinates in pixel coordinate system into coordinates in ground coordinate system, and vice versa. Through converting coordinates in a coordinate system, we can support bi-directional search and display of video data and geographic information. We use GridViewer component as a video data component. A database access component is a component to offer unique interface for accessing databases in server part to the upper level components, such as MapBase Edit component, GridViewer component.



[Figure 2] System Architecture of the Designed Video Geographic Information System

4.2 A Data Model to Represent Connection Information

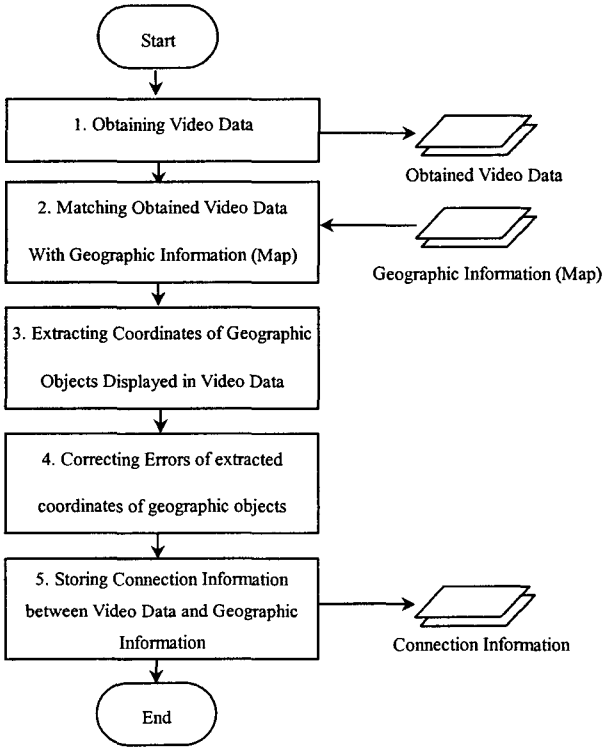
Figure 3. shows the proposed ER data model to support bi-directional search. In the proposed ER data model showed in figure 3, there are four entities which represent geographic information, video data, activity for obtaining video data, and database. A geographic object entity has an identification number of the geographic object, ground coordinates, a description and so on as it's attributes, and a video data entity has contents, a name, and an identification number, size of the video data, the ground coordinates of the region in which the video data are obtained and so on as it's attributes. An entity which represents an activity for obtaining video data has the number of frames in the video data, a description, and so on as it's attributes, and a database entity has database name, the location and so on as it's attributes. The table schema to store all kind of data is made based on the ER data model showed in figure 3.



[Figure 3] A Data Model for representing Video Data, Geographic Information, and Connection Information

4.3 Construction of Connection Information between Video Data and Geographic Information

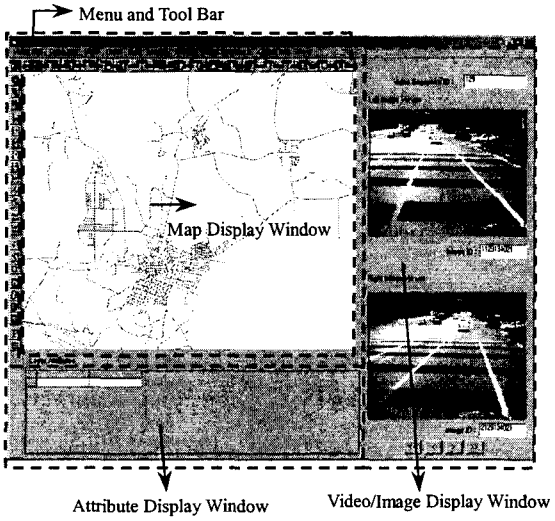
The process to extract and to construct connection information between video data and geographic information is composed of 5 steps as showed in Figure 4. In step 1 we obtain video data using camera attached a car and attaching a GPS signal receiver. By using a GPS signal receiver, we can know where the video data were obtained. In step 2 we load geographic information of the region in which the video data are obtained. In step 3 we extract the pixel and ground coordinates of geographic objects appearing in the obtained video data. In step 4 we adjust and correct the possible errors manually. In step 5 we store obtained information, such as the location of geographic objects in the video data as connection information.



[Figure 4] A Process to Construct Connection Information

4.4 User Interface and Operations of the Designed System

Figure 5. shows the user interface of the implemented system. We used MS Visual Basic 6.0 on MS windows 2000 platform and ZEUS DBMS[5]. We selected a road located in front of the Ja Woon university in Daejeon, Korea, as a region for testing.



[Figure 5] User Interface of the Designed System

The client program of the implemented system is composed of 4 windows showed in Figure 5; Map display window, attribute display window, video/image display window, and menu and tool bar. Map display window and attribute display window are linked with map component, and video/image display window is linked with video data component internally. Map display window and video/image display window always

display geographic information and video data of the same area. Menu and tool bar iconize the functions supported by each component.

Bi-directional search is executed through displaying the result of searching video data in map display window and displaying the result of searching geographic information in video display window.

5. Conclusion

In this paper, we designed and implemented a video geographic information system which supports bi-directional search of video data and geographic information. To do this, we 1) proposed an ER data model to represent connection information related to video data, geographic information, 2) proposed a process to extract and to construct connection information from video data and geographic information, 3) showed a component based system architecture to organize a video geographic information system.

6. References

[1] "A Study on the Development of Open GIS Component Software," Research Report, Electronics and Telecommunications Research Institute (ETR) , pp. 80~86, Dec. 2001.

[2] Hea-Ok Choi, Kwang-soo Kim, Jong-Hun Lee, 2001. Dec. "Open GIS Component Software Ensuring an Interoperability of Spatial Information," *The KIPS Transactions*, Part D, Vol 8-D, No. 6, pp. 657-664, Dec.

[3] OpenGIS Consortium, Inc., "Open GIS Implementation Specification : Grid Coverage, Revision 1.1", Jan. 2001.

[4] T. Navarrete, 2001. "VideoGIS: Combining Video and Geographical Information", *Research Report*, Pompeu Fabra Univ. Dept. of Computer Science and Communication.

[5] http://www.ktdata.co.kr/home_eng/english.htm

[6] http://www.mediamapper.com

[7] http://www.iwane.com/eiwane520.html