WOOPO WETLAND ECOSYSTEM MANAGEMENT BASED ON INTERNET GIS

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ABSTRACT

Korean government has recently come to show higher interest in the importance of wetland management. In particular there has been increased concern with Woopo wetland, one of the largest wetland in Korea. Unorganized involvement by numerous expert and civic groups have led to unsystematic, individual data collection and management. As a solution to this problem, this study suggested a pilot system based on Internet GIS which could help to ensure enhanced data management on Woopo wetland as well as information sharing. The system consists of Client, Web server, and Map server, and also a pilot database was constructed based on the survey data collected from expert and civic groups.

1 INTRODUCTION

Ramsar Convention, concluded in the city of Ramsar in Iran for world-wide wetland preservation (C. Kelin, 1999), obligates member nations' efforts and interests in wetland management, and requires each member to designate and manage at least one wetland. Woopo wetland is one of the biggest natural wetland, formed by ground collapse about 140 million years ago. Woopo wetland is home for 435 species of plants including 59 aquatic plants, with animal and plant species totaling 900 to 1000. If the ecosystem of Woopo wetland were destroyed, the aquatic plants and animals would lose their habitats for survival once and for all. Therefore, to ensure effective preservation of Woopo ecosystem, continued and precise surveys on the ecosystem shifts must be performed to make prediction for future changes. Fortunately, unsparing efforts by the government, experts in various fields, and civic groups have helped to accumulate survey data.

The collected data, however, is getting uncontrollably dispersed and haphazard because Woopo ecosystem research and management involves numerous people in various fields. It has become necessary to develop a system that can collect existing data and make it possible to enter new data on a database. The introduction of Internet GIS, coupled with rapid expansion of the Internet, has made it possible to use GIS analysis functions on the Internet. The pilot system proposed in this study is expected to mark a milestone in Woopo wetland data management.

2 SYSTEM CONSTRUCTION USING INTERNET GIS

2.1 Environments of the System.

Windows NT Server was employed as the operating system for this system, MIIS (Microsoft Internet Information Server) as Web server, and ArcView as Map server, and ArcView IMS (Internet Map Server) was adopted to make

connection between Map server and Web server (ESRI, 1997). Java JDK 1.2 was used to construct user interfaces so that users log on Web server through Web browser to have access to the data.
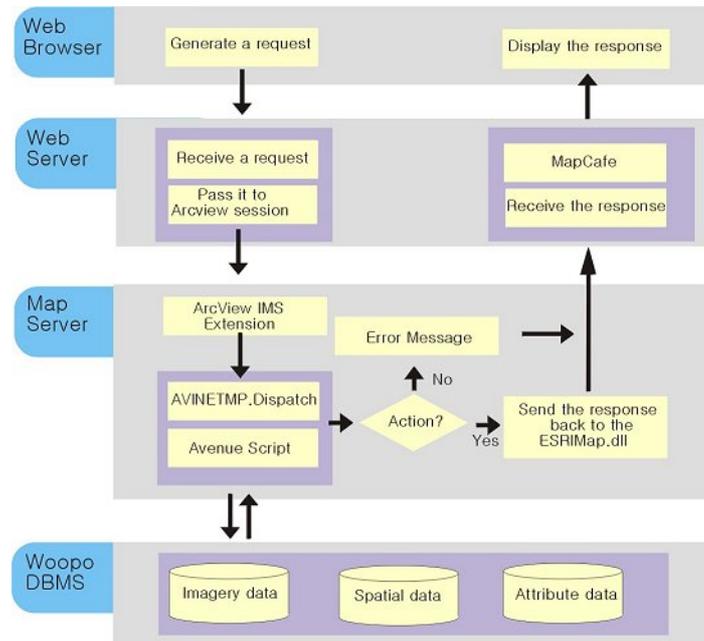
Figure 1. Data processing in Internet GIS

2.2 The System Development

2.2.1 Client Design

To support GUI (Graphic User Interface) for users' Web browser, ArcView IMS provide such Object Models as AboutBar, ButtonBar, MapCafe, MsgBox, StatusBar, ToolBar, and XYDisplay, and each Object Model has its own Methods. ArcView send requests to these Objects to control and display maps on Web browser.

In this study, the six following HTML files were composed to construct GUI on users' Web browser : mypage.html (a default page to support Web server), mypageapplet.html (to support functions of Java), mypagetitle.html (the title of Web page), mypageextra.html (to support message of Web page), mypageinitial.html (to support management and view of attributes), and mypageload.html (to support download message of Web page).

A user logging on Web server through Web browser can begin by clicking buttons on ToolBar in order to request data from Map server.

2.2.2 Web Server Design

Web server's substantial role is to connect users logging on the Internet to Map server. Detail directory contains the HTML documents which is linked to the data supplied by identity tool. Image directory includes the imagery for Web server. V1a directory involves Java class files for map display and user interface.
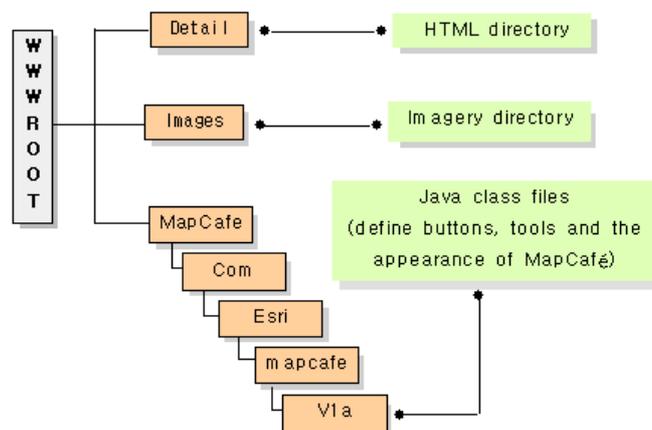
Figure 2. Directories of Web server

2.2.3 Map Server Design

Map server receives users' message from Web server via ArcView IMS Extension and check out data processing type. In the next stage Map server execute the Avenue script corresponding to the message before sending processing results to Esrimap.dll, which in turn transmit the result processed in Map server to users' Web browsers.

In order to send back the processing results of requests to Web server, Web server users' are username and password must be registered.
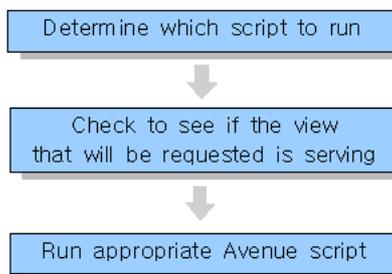

Figure 3. Avenue script process in Map server

2.3 Construction of Database

As was mentioned in Introduction, the data was not organized enough to be used for database construction. For this reason, a pilot database was constructed from the following data : a) on temperatures, humidity, precipitation, shining hours, the number of foggy days; b) fish and shells, plants, aquatic insects, birds, and water pollution measured in the designated investigation spots. For plant survey, aquatic and surrounding plants were surveyed on seasonal basis. Based on these data, individual aquatic tracheophytas were classified into Order, Family, Genus, and Species. Four sampling spots for insect were designated to registered the number of insect species and their individual numbers were registered on a seasonal basis. The whole Woopo wetland were divided into four zones in order to register the number of birds, fish and shell on monthly basis. For water pollution investigation, eight observation spots were established in order to investigate pH, DO, BOD, COD, SS, T-P, T-N, and water temperatures.

3 ANALYSIS FUNCTIONS

3.1 Logging on the System and Data Input

To log on the database, users first have to enter URL on Web browser. The users were divided into expert, system manager, and general user groups, and the ranges of database accessibility and service contents were assigned differently depending on the groups. System manager makes all decision on the system operation and is in charge of user group management. In order for experts to make access to the system database, it is necessary to get a user ID from a system manager and to enter a password. Those in general user group can type "guest" in ID and password in order to log on the system (Fig. 4).; they are not allowed to input or correct data.

Those who log on as a member of expert group are allowed to input newly surveyed data in data input window presented in Fig. 5. The data accumulated through Web is integrated and managed in Woopo database and is offered to other experts and general users.
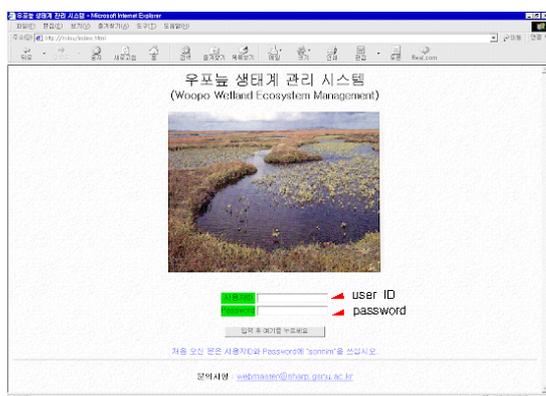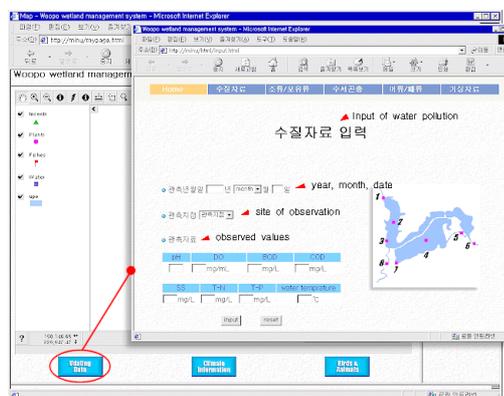

Figure 4. Accessing the System

Figure 5. Updating data on Internet

3.2 Data Search Function

The system is designed to supply information on climatic changes in Woopo wetland by constructing data on temperature, humidity, precipitation, shining hours, and foggy days on yearly and monthly basis.
When users choose particular survey spots on Web browser, plant and animal species are displayed in a table. When users choose a species of interest, the picture of the species is displayed (Fig. 6). In addition, if the name of a specific species is keyed in, the system display a magnified image of the species' habitat.
Eight surveying spots were designated in order to measure the pH, DO, BOD, COD, SS, T-N, T-P, and water temperature of each spot and to construct the observed values into the database. When users choose one of the eight spots in Map, data on each of the items is displayed. In addition, when a particular area of Woopo wetland is selected, the maximum, minimum, and average values of the measurements on the area are displayed (Fig. 7).
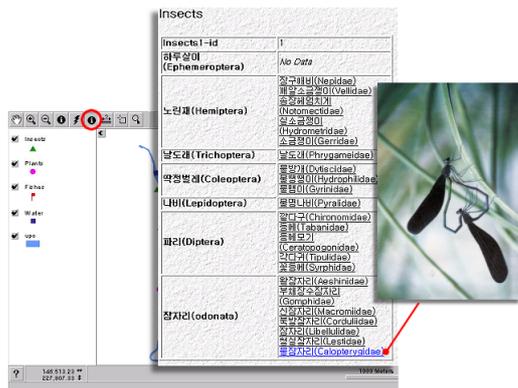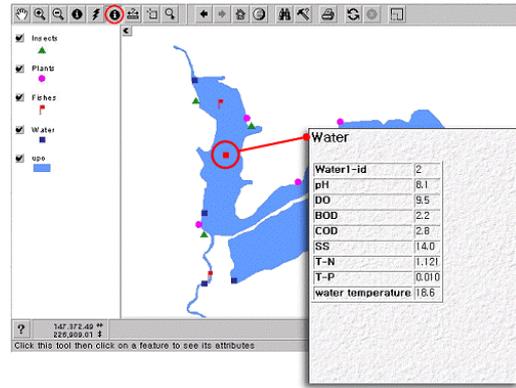

Figure 6. Insects browsing

Figure 7. Analysis of the water pollution

3.3 Spatial Analysis Function

When users log on the system through Web browser, they can search out and analyze spatial data and attribute data interrelated with all the other various data constructed in the database. If users want to make conditional analysis of Woopo wetland data, they can open up query tool window and input analysis conditions, which highlights the color of the desired survey spot and analysis result is displayed in the right window; Fig. 8 shows query tool window. Other available function are ; coordinates display by mouse position, distance indication between survey spots, square measure of areas represented as polygon, attribute data search, and buffering.
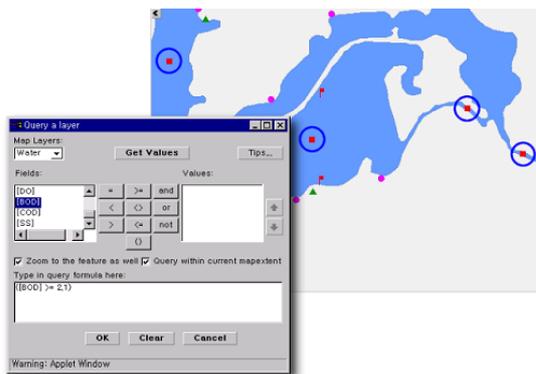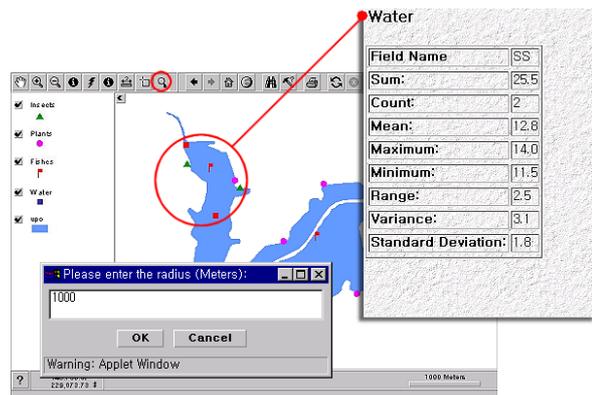

Figure 8. Data query

Figure 9. Analysis of data with buffering

4 CONCLUSIONS

Woopo Wetland, with 900 to 1000 species of plant and animal inhabiting there, has become one of the most important wetland ecosystems in Korean where various expert, civic groups and government agencies have performed diversified surveys to preserve and manage its pristine environment. this study suggested a pilot Woopo wetland management system based on Internet GIS in order to ensure data accessibility and sharing for expert and civic groups, who thus can add to, share and analyze Woopo ecosystem data.

The following data on Woopo wetland was incorporated into the database: a) temperatures, humidity, precipitation, shining days, and foggy days; b) shells and fish, plant species, aquatic insect species, birds, and water pollution in each of the observation spots. Users can log on the Internet to have access to the data obtained in each observation spot and images of plant and animal species inhabiting there. By means of query tool window, it is also possible to search out attribute data on users' desired conditions, and such spatial analysis functions as coordinate display, distance calculation, and buffering are supplied by the proposed Internet GIS-based system.

To ensure effective management of the database, the Web loggers were divided into system manager, expert, and general user groups. Each group was given an ID and a password whose range of data storage, correction and accessibility were designated differently. Experts can have an access to the system and to store and share data, since the system is Internet-based.

ACKNOWLEDGEMENTS

REFERENCES

Chen Kelin, 1999. The Ramsar Sites in China and Importance of International Cooperation. Proceeding of International Symposium for The Ecological Values and Management of the Woopo Wetland as a Ramsar Site, Pugok Royal Hotel, Korea, pp.9-18.

D. J. Rapport, W. G. Whitford, and K. Korporal, 1996. Evaluating Ecosystem Health : Opportunities for GIS. GIS Applications in Natural Resources 2, Edited by Michael Heit, H. Dennison Parker and Art Shortreid, GIS World Books, pp.408-413.

ESRI, 1997. Using ArcView Internet Map Server.

Sooil Kim, 1999. Roles and prospects of Restoring Oriental white Storks in the Woopo Wetland. Proceeding of International Symposium for The Ecological Values and Management of the Woopo Wetland as a Ramsar Site, Pugok Royal Hotel, Korea, pp.45-60.

Zhong-Ren Peng and Douglas D. Nebert, 1997. An Internet-Based GIS Data Access System. Journal of the Urban and Regional Information Systems Association, Vol.9, No. 1, pp.20-30.