Constructing the integrated information system for the coast disaster area management using 3D web GIS technology

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Abstract : The damage scale and damage area in the coast have been increased dramatically because of calamities such as typhoon, tidal wave, flood and storm. Especially, 409 cases, which reach to about 40.9% of natural disasters of 1,000 cases for the recent 15 years have happened on coast area. More than 40% of natural disasters also occurred every year is happening in coastland.

Therefore, there is a great need to construct all related GIS database such as atmospheric phenomena (typhoon, tidal wave, flood and storm), harbor facility, harbor traffic and ebb and flow. Furthermore, the certain system should be developed and integrated with NDMS (National Disaster Management System) by using 3D web GIS technology.

In this study, the coast disaster area management system was designed and developed by using 3D web GIS technique so that the coast disaster area could be monitored and managed in real time and in visual.

Finally, the future disaster in coast area could be predicted scientifically.

Keywords: 3D web GIS technology, Coast disaster area management system, NDMS (National Disaster Management System)

Ⅰ. Introduction

The coast has been very weak to calamity such as typhoon, tidal wave, flood and storm. Especially, 409 cases, which reach to about 40.9% of natural disasters of 1,000 cases for the recent 15 years (1989 - 2002), have happened on coast area. More than 40% of the natural disasters also are occurring every year is happening in coastland.

However, the NDMS (National Disaster Management System) of National Emergency Management Agency has still focused on the restoration, which could be useful information for the only charged officers. Moreover, it is mainly stored in DBMS as a text format so that it is difficult to acquire detail information in the damaged area. So, in order to prevent these coast disasters effectively there should be effort of not only the central government and but also the people in Korea.

In this study, GIS DB was first constructed by acquiring damage factor data such as typhoon, tidal wave, flood and storm for recent 10 years (1989 - 2002) in study area and then the coast disaster area management system was developed to possibly present the results of retrieve as table, map and graph also simulate the inundation after heavy raining by using 3D web GIS technology.

Through this system the general users can obtain the whole information related to coast disaster visually in real time also recognize disaster prevention. In addition, the charged officers related to this can support related to this policy and can have the infrastructure foundation on scientific and systemic the coast disaster area management through rapid input, various retrieval and visual output.

Finally, this system can show the possibility of performing as DSS (Decision Supporting System) for the Korean prevention method against coast disaster by analyzing spatial-temporally related to damaged area.

Fig. 1 shows the study areas where are 76 cities along Korean coast, Masan city.

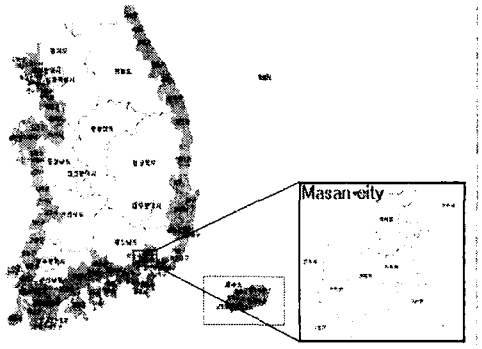

Fig.1. The study area (76 cities along Korean coast, Masan city)

II. Material and method

In this study, 78 cities along the Korean costal area were selected in order to manage in the coast vulnerable area. The various thematic maps such as topography, 2D or 3D facility, road, stream, administrative boundary, labeling, harbors, fishing port, breeding ground, national industry area, swimming beach were classified from national digital map based on 1:5,000 and 1:25,000 scale and transformed its coordination by using ICM (Integrated Costal management).

In addition, the attribute data, which is based on disaster annual report, disaster white papers and inventories for recent 10years (1994-2003), has been constructed in DBMS. To design and implement this system, HTML, JSP and Java scrip are used for web server and Oracle 8i is used for database, respectively. Also, Geomap Development Kit of INNOGEO GDK is used to serve dynamic 3D map on web.

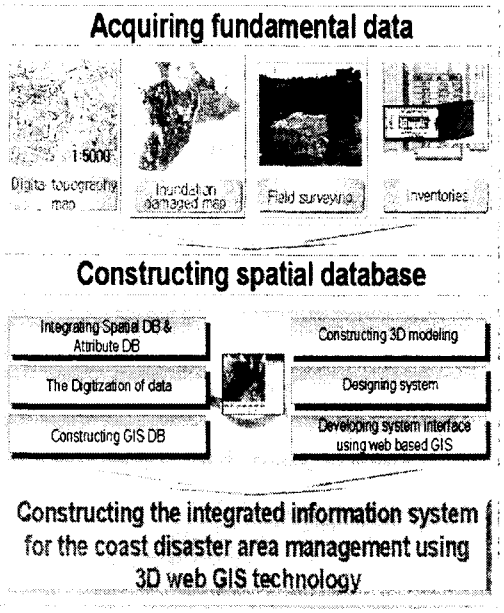

Fig.2. The study flow chart for web based coast disaster area management system

III. Development of web based coast disaster area management system

As you see in Fig. 3, the system operation structure is consisted of client side, middle ware and server that is corresponding on users, map server, web server, respectively (3-tier). System users request their desired results through web server using certain browser to map application server, which is located in map server.

In this paper the system interface development is focused on API (Application Programming Interface) methodology. To implement this system, HTML, JSP, and Java scrip are used to construct web server and Oracle 8i is used for database construction, respectively. Also, Geomap Development Kit of INNOGEO GDK is used to serve dynamic 3D map on web as shown in Fig. 3.

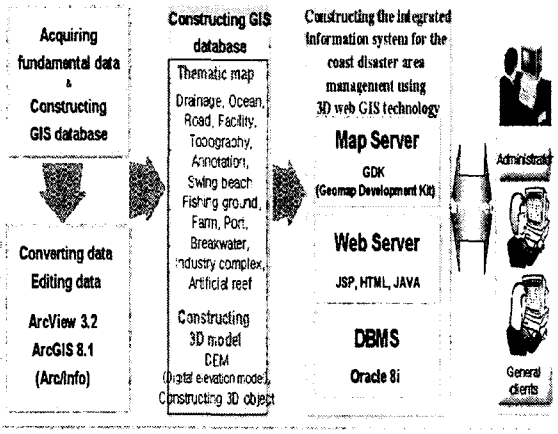

Fig. 3. The concept diagram of system development

3. 1 System network configuration

This system network configuration diagram is presented for Internet services. As you see here, this system is operated in distribution network environment. All operations corresponding on user requests are performed in client side.

In order to access to this system each local official has to be granted his ID and password and database access authentication from the system DBA (Data Base Administrative) in central government officials before operating this system while general users can access to the system without ID and password. Finally, the system DBA has the hierarchical database access authentication information.

General users can only retrieval general costal disaster information such as tendency and water etc. in text format while officers can input, retrieval, update, delete all text data and perform simulating flood disaster by using 3D web GIS technology.

Fig. 4 shows the system network configuration diagram.

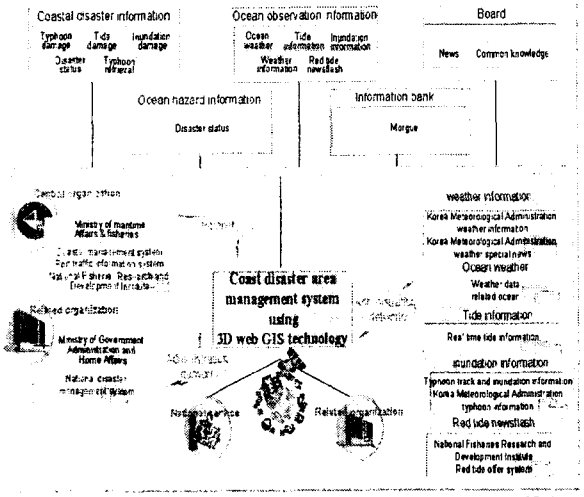

Fig. 4. The system network configuration diagram for efficient operation

3. 2 Implementing system interface by using web based 3D GIS technology

■ *The interface for fundamental GIS function*

The damage factor information about typhoon, tidal waves, flood and inundation and the disaster damage factor information about water and ebb and flow were stored in DBMS and presented in various thematic maps, layers, 3D viewers and statistical information (graph and choropleth map).

For the efficient user interface and convenience the main interface it expects to have tool bar having the functions such as print, zoon in/out, pan, measuring distance and area, overlaying various thematic maps, map window, retrieval window, coordination bar, scale bar, layer controller and index map, 3D viewer, flying, rotation and flood simulation as show in Fig. 5.

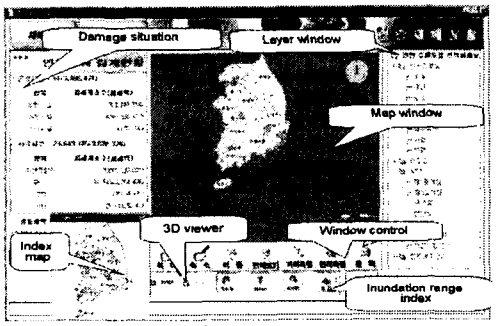

Fig. 5. System main interface

■ *The interface for retrieval of statistical information*

In this system any related officers, who does not have any knowledge on SQL, can retrieval their desired information through user-friendly interface. Also, the result of it presents in text, graph and map format. It helps that not only users understand the recent disaster tendency more easily but also officials have useful reporting information for decision supporting system.

The below figures show the example result of retrieval in table, graph (pie, bar, line) and choropleth map, respectively. In this system all information stored in database can be presented in visual way as shown below.

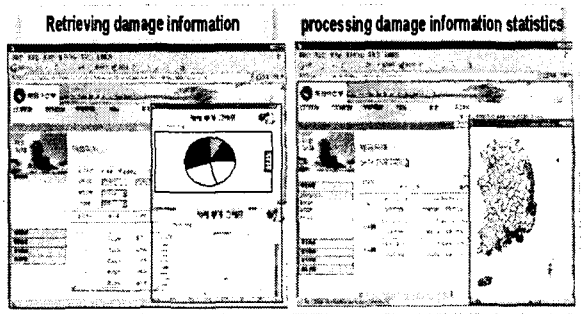

Fig.6. The retrieval interface of statistical information (graph and choropleth map)

■ *The interface for real time information related to coast disaster*

The damage factor related to coast disaster such as weather and ebb and flow could be acquired by connecting other related organization such as Korean Meteorological Administrative as show in Fig. 7.

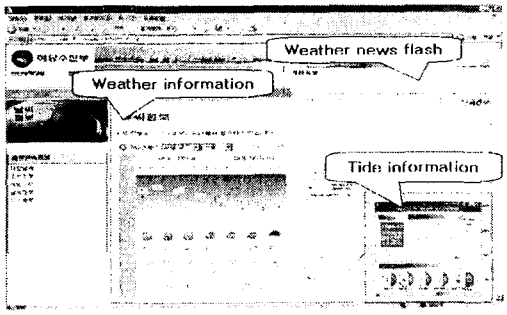

Fig.7. The real time weather/ebb and flow information

■ *The interface for the flood disaster simulation by using 3D web GIS technology*

The 3D flood simulation could be performed on 3D viewer and its flying and rotation from various angles on desired maps also could be also implemented. Especially, the 3D flood simulation could present the overflowed status depending on the height of sea in study area and indicates the high hazard area.

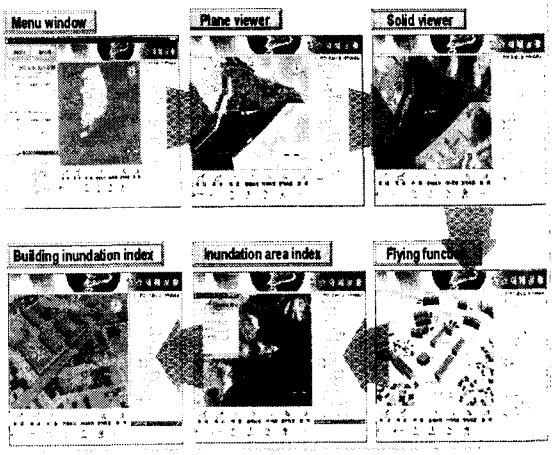

Fig.8. The flood disaster simulation by using 3D web GIS technology

IV. Conclusion

The damage scale and damage area in the coast have been increased dramatically because of calamities such as typhoon, tidal wave, flood and storm. Especially, 409 cases, which reach to about 40.9% of natural disasters of 1,000 cases for the recent 15 years (1989~2002) have happened on coast area.

However, the NDMS (National Disaster Management System) of National Emergency Management Agency has still focused on not the prevention of this disasters but the restoration, which could be useful information for only charged officers. Also, this information related to restoration is not enough to manage the whole damaged area.

In this situation, 78 cities along the Korean costal area were selected in order to manage in the coast vulnerable area. The various thematic layers such as topography, 2D or 3Dfacility, road, stream, administrative boundary, labeling, harbors, fishing port, breeding ground, national industry area, swimming beach were classified from national digital map based on 1:5,000 and 1:25,000 scale and the attribute data, which is based on disaster annual report, disaster white papers and inventories for recent 10years (1994-2003), has been constructed in DBMS.

Also, the coast disaster area management system was developed to retrieve spatial information, control map view, provide related to information such as weather and ebb and flow and simulate inundation after heavy raining through using 3D web GIS technology. Finally, this system can show the possibility of performing as DSS (Decision Supporting System) for the Korean prevention method against coast disaster by analyzing spatio-temporally related to damaged area.

In near further, this coast disaster area management system is expected to work as efficient DSS (Decision supporting system) against domestic coast management by constructing the GIS DB of the whole coast area in Korea, implementing the various disaster simulation modeling and method and developing the efficient user interface.

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