Developing the 3D high-resolution forest mapping system using satellite images and GIS

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Abstract: Recently the domestic technologies to manage forest and to control all related information were developed very rapidly by integrating FGIS (Forest Geographic Information System) and IT (Information technology). However, there still exists a mapping problem for example when overlaying a topography maps scaled in 1/5,000 to a forest type map scaled in 1/25,000.

Moreover, there is a greater need to introduce the advanced spatial technologies such as high-resolution satellite image such as IKONOS and GIS to forest.

In this study, 3D high-resolution forest mapping system was developed to possibly overlay with all kinds of scale maps and provide the all detailed information by using high-resolution satellite image and GIS.

Through this system, all related forest officials could have and maintain the data consistency for their job and share the standard forest database with other post.

Keywords: 3D high-resolution forest mapping system, FGIS, IKONOS, GIS

1. Introduction

Recently the domestic technologies to manage forest and to control all related information were developed very rapidly by integrating FGIS (Forest Geographic Information System) and IT (Information technology). However, there still exists a mapping problem for example when overlaying a topography maps scaled in 1/5,000 to a forest type map scaled in 1/25,000.

In this situation, there is a greater need to develop 3D high-resolution forest mapping system, which can mange even detailed information about forest through using advanced spatial technologies such as high-resolution satellite image and GIS.

In this study, 3D high-resolution forest map scaled in 1/5,000 was first constructed and then its application system was developed to possibly overlay with all kinds of scale maps and provide the all detailed information.

The result of constructing this system helps to manage domestic forest scientifically and effectively within shorter time then reduces support the standard for domestic forest information. Finally, this system is expected to become the foundation of scientific and effective domestic forest policy

This system was developed based on Windows 2000 and implemented by using Visual Basic 6.0 as development programming language, Map Objects 2.1 of ESRI as GIS component and Access 2000 as DBMS, respectively.

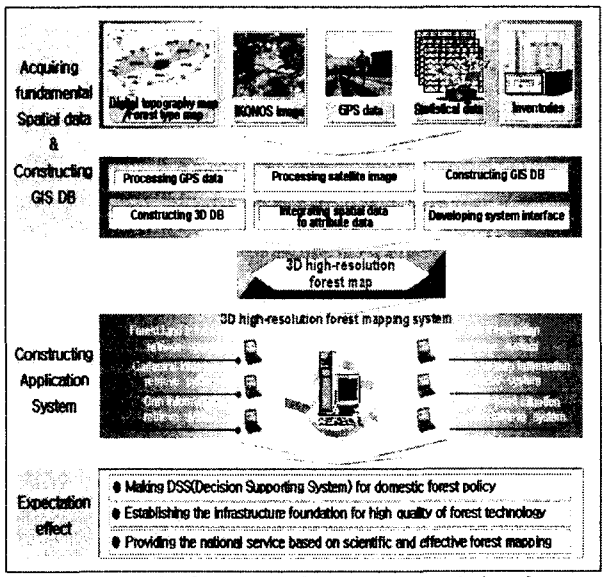

Fig. 1. The study flow chart for 3D high-resolution forest mapping system

2. Materials and method

Fig. 2 shows the study areas, which are called as Hoch'on, Kujwa, Aewol and Hallimare in Jeju. In order to perform the entire forest detailed survey, the interpretation of high-resolution satellite images and classification and GPS data survey were performed in this study. Also, the various GIS layers such as topography map, forest type map, forest cadastral map and cave distribution map etc. and the attribute data based on forest inventories were constructed.

In addition, the sample points of vegetation, soil and forest site index were recorded on topography map scaled in 1/5,000.

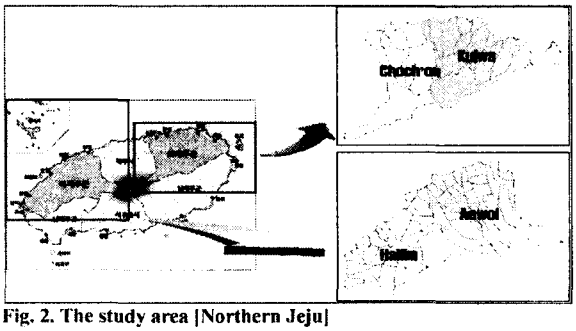

Fig. 2. The study area [Northern Jeju]

III. Constructing 3D high-resolution forest map

3.1 The field survey

For the classification of forest type information, the definition of diameter class, non forest land, crown density, tree height, tree species, age class, forest type, forest species, mixed tree rate should be fixed as shown in Fig. 3.

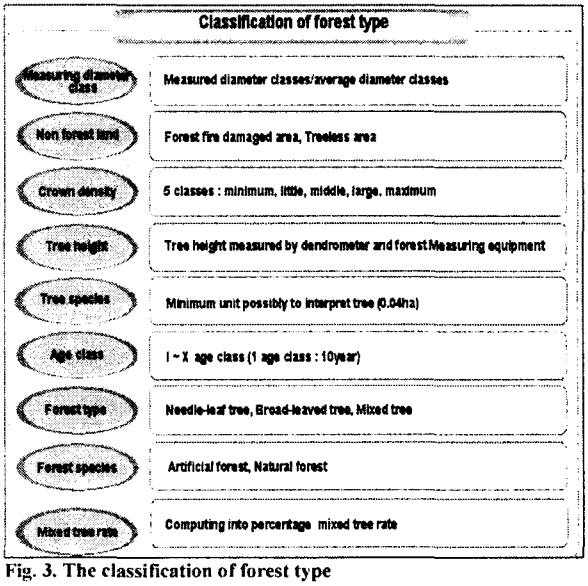

Fig. 3. The classification of forest type

3.2 The steps for constructing 3D high- resolution forest map

For the efficient forest management, 3D high-resolution forest map should have the information of vegetation classification and a green belt. The status of entire forest distribution such as classification of forest type and forest area size in Jeju could be understood through this 3D high-resolution forest map.

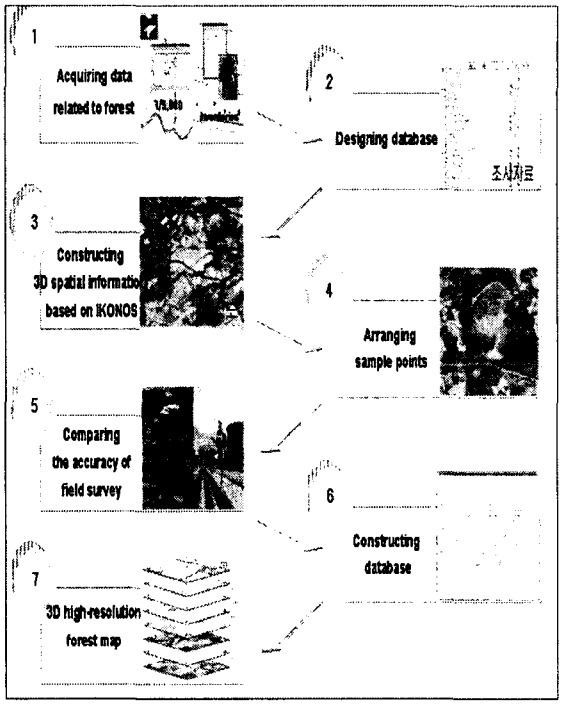

Fig. 4. The main steps for constructing 3D high-resolution forest map

■ *Constructing satellite images DB*

IKONOS was first preprocessed such as geometric correction, ortho rectification and mosaic, interpreted and classified for the fundamental forest resource information.

Also, this satellite images was performed in images compression method, which is called as MrSID(Multi Resolution Seamless Image Database) to optimize.

■ *Constructing GIS DB*

The various thematic maps such as drainage, road, facility and topography form digital topography map scaled in 1:5,000 were classified and converted on proper purpose.

■ *Constructing attribute DB*

In order to construct the attribute DB, the survey data, forest cadastral data, statistical data based on inventoried were into stored in DBMS (Data Base Management System) and mapped to its desired spatial data.

IV. Developing 3D high-resolution forest mapping system

This system was developed based on Windows 2000 and implemented by using Visual Basic 6.0 as development programming language, Map Objects 2.1 of ESRI as GIS component and Access 2000 as DBMS, respectively under intranet network environment.

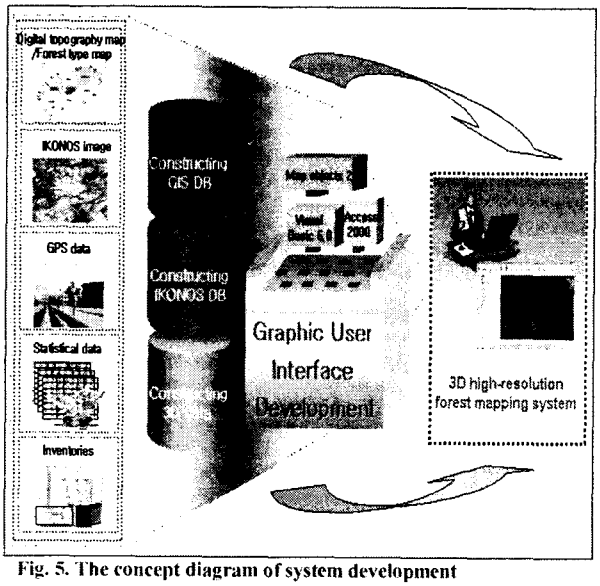

Fig. 5. The concept diagram of system development

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 as shown in Fig. 6.

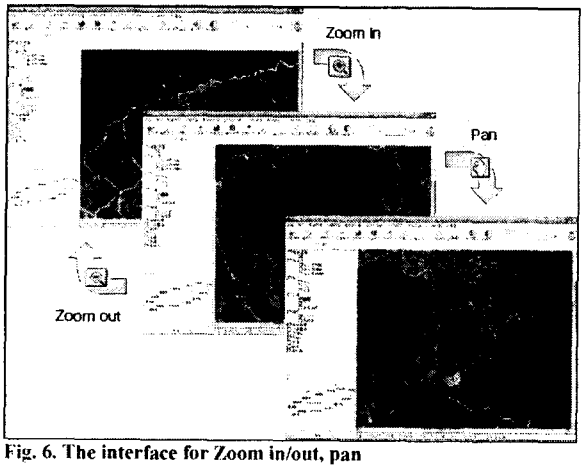

Fig. 6. The interface for Zoom in/out, pan

Fig. 7 shows the interface for GIS overlay analysis such as topography map, forest type map, forest cadastral map and satellite images.

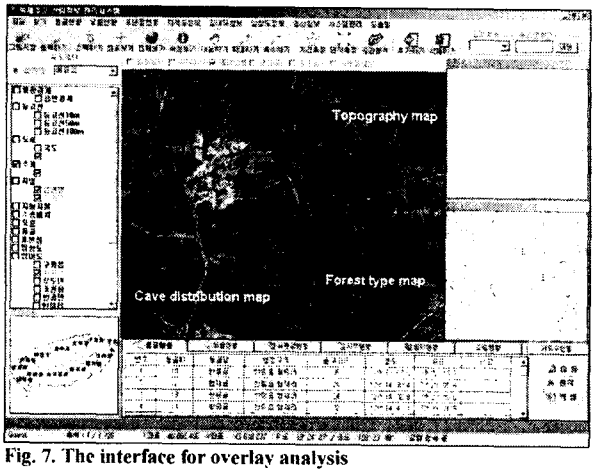

Fig. 7. The interface for overlay analysis

Fig. 8 shows the retrieval interface that map forest cadastral spatial information to its attribute information on map.

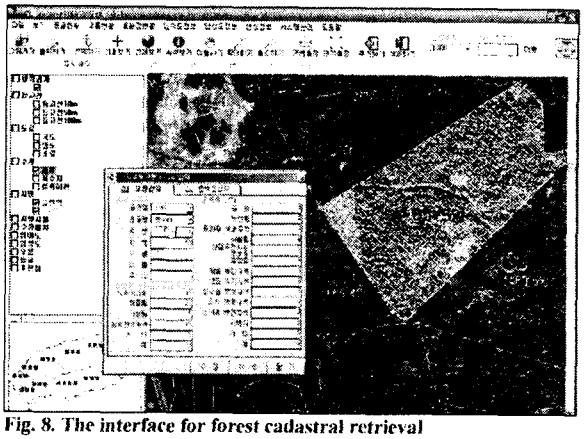

Fig. 8. The interface for forest cadastral retrieval

Fig. 9 shows the advanced retrieval interface about sample points of vegetation, soil, and forest site index on satellite image.

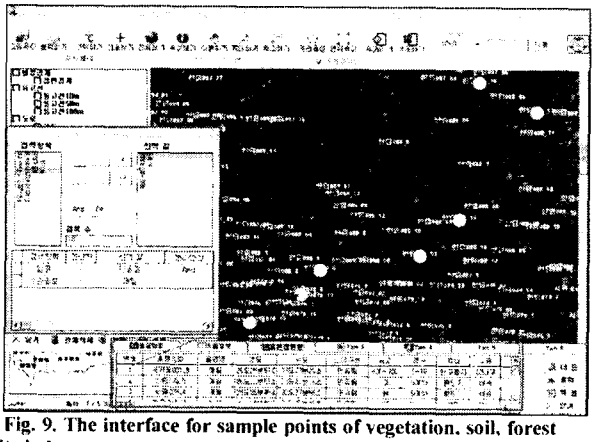

Fig. 9. The interface for sample points of vegetation, soil, forest site index

Fig. 10 shows the interface for mapping forest arrangement so that forest officers could establish and make a forest arrangement map.

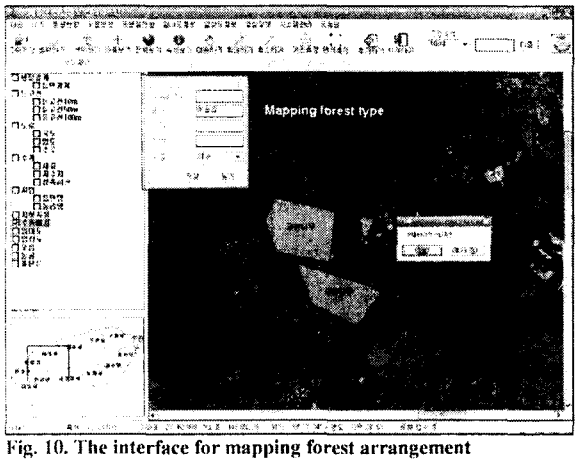

Fig. 10. The interface for mapping forest arrangement

Fig. 11 shows the interface for 3D information based on DEM and IKONOS.

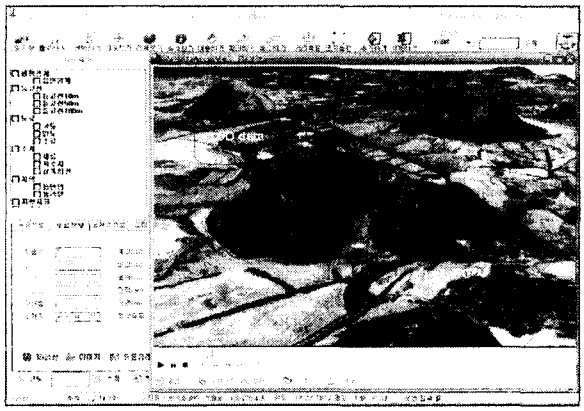

Fig. 10. The interface for 3D data

V. Conclusion

In this study client/server based 3D high-resolution forest mapping system was developed by using 1m high-resolution satellite images and forest detailed information map scaled in 1/5,000.

The result of constructing this system helps to manage domestic forest scientifically and effectively within shorter time then reduces support the standard for domestic forest information. Finally, this system is expected to become the foundation of scientific and effective domestic forest DSS supporting data such as statistical information of graph, table and map. Moreover, forest officers can manage the domestic forest resource efficiently and scientifically by analyzing and retrieving huge forest data through this system on the center of Korea Forest Service. So, they can save their manpower, time and cost to collect and manage data.

Finally, these all motivation can be constructed as the foundation of domestic infrastructure for forest policy.

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