Implementation of a Seamless Database and n-Demand-Mapping On 1:25,000 Scale Maps of IRAN

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Abstract

This paper outlines implementation of a seamless database and On-Demand Mapping on 1:25K scale National Topographic Database (NTDB) of Iran, produced by National Cartographic Center (NCC).

In this research, Gothic object oriented database and Laser-Scan LAMPS-2 were selected as software environment. 24 map sheets of 1:25K scale maps with their associated attributes covering Neyriz area of Fars Province in the south of Iran were used for a pilot test.

Using LULL (Laser-scan Users Programming Language) some applications were developed for joining and storing data seamlessly in Gothic database as well as On-Demand Mapping.

1. Introduction

Real world is continuous, and all of the features and objects are joint together without any disconnection by regular man-made tile edges. In some Geographical Information Systems (GIS) due to some problems such as limitation of memory, problems with managing huge amount of data and etc, the real world is modeled in different files/databases and map sheets divide features and objects to several parts. For example, a river (linear object) may lay in 5 map sheets, therefore, it is divided to 5 individual objects.

Sheet based modeling of the world causes some differences between the real world and the modeled world that affect the result of processes and analyses. For example topology has not been defined completely and objects are broken to several parts. As a result in some cases data redundancy and difficulties in database management will be occurred. New advances in database management, GIS technology and computer science have solved the above mentioned problems with modeling the world seamlessly. Modeling the world in a seamless file/database in such a way that all of the objects joint together causes modeling the world more realistic. In this regard using object-oriented technology, which, has the ability of handling large databases and models the world by removing layer concept and defining the class concept and many other new concepts and advantages, helps on more realistic modeling of the world.

Seamless data basing has some advantages as follows:

- Modeling the world is more realistic.

- Data redundancy is reduced, because in the seamless database, attribute data are stored once for each object, but in the case of sheet base, attribute data are stored in different tables for each part of an object in different sheets.
- Seamless topology is supported.
- Analysis is easier and more complete. For example, network analysis in area wider than area of one sheet.
- On-Demand Mapping is possible

This paper outlines implementation of a seamless database and On-Demand mapping on 24 map sheets whit scale of 1:25k which are produced by National Cartographic Center (N.C.C) of Iran.

2. National Topographic Data Base (NTDB):

Production of 1:25k scale topographic maps of Iran were started from 1990 by NCC. These maps have been produced using photogrammetric techniques and covering whole country.

Spatial data are stored in Microstation with DGN format and attribute data are stored in Oracle. Spatial data in each sheet are fully structured and then edge matched with neighbor sheets. Then all of the data are quality controlled.

Although it is tried to produce structured data in NTDB by applying different processing and editing operations, however NTDB has some disadvantages as follows:

- Data are stored sheet wise.
- Every map sheet has its specific attribute database.
-
   in different related databases.
- The above-maintained problems have caused data redundancy in NTDB.
- The environment that NTDB is constructed based on, is not suitable for GIS analysis.
- Data are not topologically structured
- Requiring an area covered by quadrants of 4 map sheets, make using by 4-map sheet in place of one (figure.1). Means On-Demand Mapping is not supported by NCC.
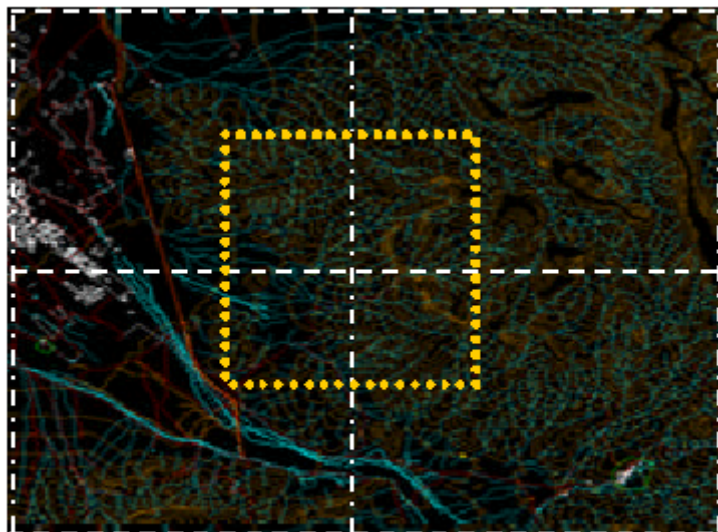

Figure.1

3. Seamless Database

In seamless Database, features are not broken to two or many individual parts by the edge of the sheet maps. Every feature is displayed and treated as a continues and unique identity managing geographical data.

There are two main methods for implementing a seamless database as follows:

a) Spatial data are stored in different files, and each file is indexed in order to ease and speed up loading, displaying and accessing the data of the files. However there is just one attribute database, so every feature (object) has just one unique identifier.

b) Spatial and attribute data are stored in one database. The concept of different sheets or different files dose not exists in this method.

In this research the second method was used for implementation the seamless database over NTDB.

4. Test

The goal of this test was implementation of a seamless database and development of required tools for Mapping On-Demand on 1:25K scale maps of NTDB. Therefore a pilot test was carried out on 24 map sheets that is possible to be performed for all of the NTDB maps.

The Gothic object oriented database its user programming language (LULL) and LAMPS-2 software, were selected as required environment and tool for this purpose.

LAMPS-2 has a module which is named Manage and is used for database creation and schema definition. Using Manage a database as well as a dataset was creation for storing spatial and attribute data. The schema of created dataset was defined according to NTDB standards, so classes, subclasses and attributes as well as required threshold for topology construction were defined and created in dataset.

24 maps sheets were translated to defined dataset using Translate module of LAMPS-2. Translated files were consisted of DGN files as well as their associated attributes, which had been stored in Oracle.

After importing data to LAMPS-2 their representation style and cartographic representation of object were set for classes.

For create seamless database, a program was developed using LULL for joining the objects, which had lied in different map sheets and had been divided to two objects by the edge of the sheets. Figure 2, illustrate the structure if developed program.

```
┌─────────────────────────────────┐
│       Running the program       │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────────────┐
│ Inputting coordinates of four corner of one sheet │
└─────────────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│        Selecting classes        │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│     Introducing the threshold   │
└─────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────┐
│  Joining object and integrating their attributes │
└───────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────┐
│  End of the program and displaying the Flags │
└───────────────────────────────────────────┘
```
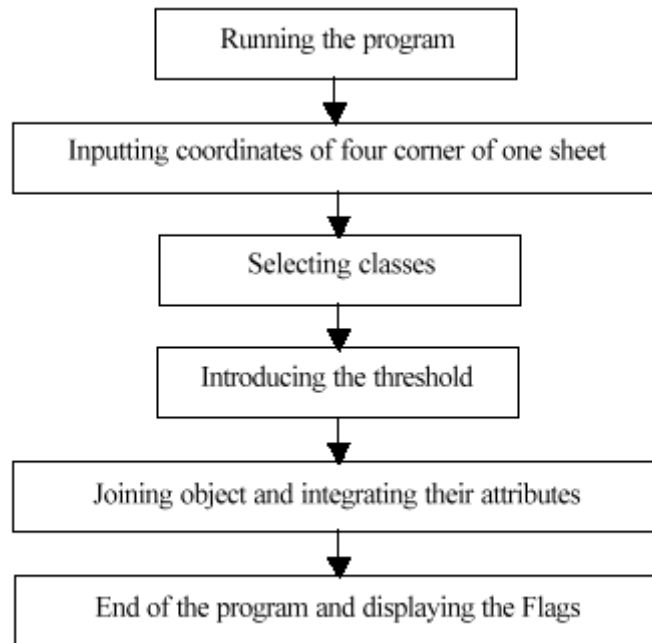
Figure.2

After running the program, the coordinate of four corner of one sheet is introduced to program, so the program can find the edge of the maps that joining objects should be carrier at around them.

Also a threshold is introduced for joining the objects that will lie in its limit.

Then the classes are selected one by one, and the objects in each class are joint together at edge of the maps, based on the introduced thresholds and similarity of objects which is distinguished from their attributes.

If two objects have similar attributes but their distance is more than the threshold, a flag is draw till the operator decides about joining them.

Another program was developed using LULL in order to produce map sheets from any area according to requirement of users; the structure of On-Demand Mapping is illustrated in figure 3.
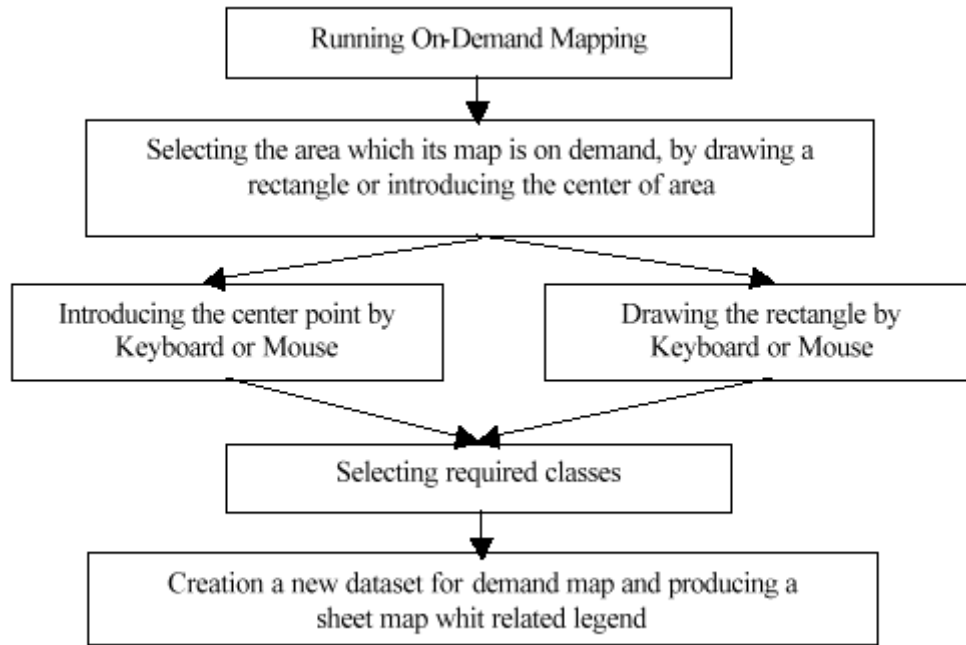
Figure.3

After running the program, introducing the region of request as well as required classes, a map sheet from selected area with selected features is produced in a new dataset.

Those object that have junction with edge of selected area are clipped. If the mentioned objects are polygon, the polygons are closed to the edge of new map sheets after clipping. Figure 4 illustrate clipping linear and polygon objects.
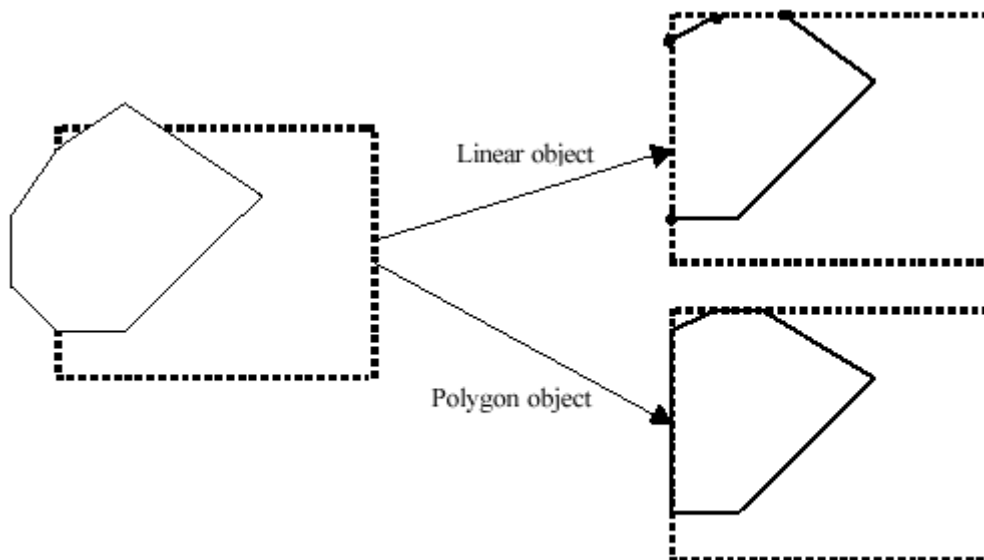

Linear object

Polygon object

Figure.4

Then topology is constructed on new dataset and the standard Border and legend of 1:25K scale maps of NCC are overlaid on it. The new produced map has all of the cartographic representations of 1:25K scale maps (Figure 5).
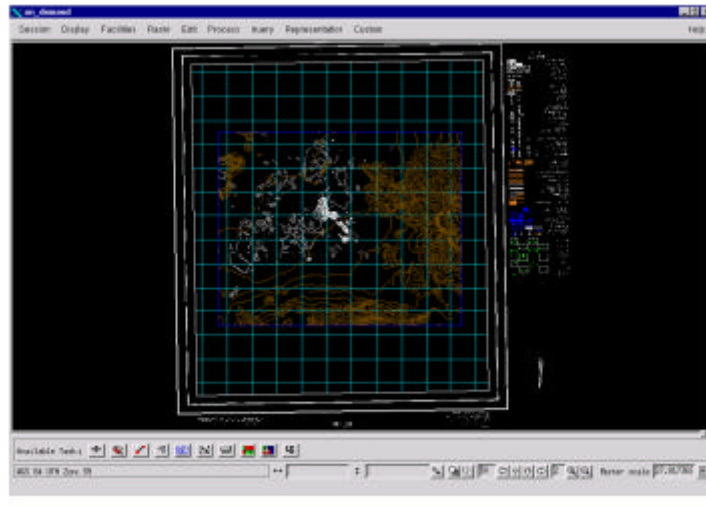
Figure.5

5. Conclusion

The result of this test showed that using a seamless database in big and national organizations that are responsible for map production and selling them to customers is very useful from data management and analysis as well as selling map to customers according to their demand point of view.

It is possible to develop this test to implement a seamless database for NCC to provide them with advantages of using a seamless database and on-demand-mapping.

Different methods of making a seamless database are going to be tested and evaluated. Advantages, disadvantages and characteristics of these methods for managing and analysis geographical data as well as topologically structuring of data will be evaluated and comprised.

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