Applications of Dynamic Representation Technologies in Multimedia Electronic Map

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Abstract

Map is one of the prominent medias for transferring spatial data and becomes more and more important in many fields. The printed map uses static symbols and graphics to represent spatial information, but the static map cannot satisfy various demands of the users in current era of information. With the development of computer technology and other related technologies, the multimedia electronic map has been used widely nowadays. The multimedia electronic map has more advantages than printed map, and the dynamic representation is most important one of them. The dynamic representation in multimedia electronic map has two meanings, one for map contents and another for visualization of map contents. The former means in a same view interface, the contents of map alter according to the view scale. The latter focuses on how to represent current contents with dynamic technologies.
The paper, firstly, introduces the characteristics and advantages of multimedia electronic map. Secondly, discusses the importance of dynamic representation in multimedia electronic map, and depicts the technologies of dynamic representation in detail, including sound, dynamic symbols, animation and virtual reality technologies etc. Finally, some examples are given to show the application of these technologies.

1. Introduction

Electronic map is visual map that is based on cartographic database and stored in outer memory of computer in the form of digits. Because it is shown generally in the electronic screen, it is called screen map. The electronic map is a new kind of map product that combines many modern technologies: GIS technology, digital cartography technology, multimedia technology and virtual reality technology etc. With the supporting of multimedia technologies (Text, music, video, animation etc.) the electronic map becomes multimedia electronic map. Multimedia technologies can be used to not only enhance the representation of spatial information, but also improve interest of reading map. The main characteristics of multimedia electronic map that distinguish from printed maps are flexibility, non-linearity, dynamics, actuality, extendibility, accessibilities and resolutions. The following possibilities of multimedia electronic map outline its advantages compared to printed map:

- Interaction with map objects. Fox example, user can select map objects by point, rectangle and polygon, or complex SQL and get spatial or spatial-related information;
- Additional dynamic cartographic variables. Such as the blinking of objects can attract user’s attention;

- Multimedia support. Multimedia technologies can be used to enhance the representation of spatial information and improve interest of reading map;
- Zooming in and zooming out:
- Individual map designed by user. User can show some layers and not show some layer, and even alter visual variables;
- Automatic reference function;
- Metric operations (distance and area measurement);
- Reasonable updating;
- Easy transportation;
- Improving modern prestige of publisher and user, and so on.

Due to these advantages, the multimedia electronic map has been used in many fields, and with the development of technologies it will become more and more important in daily life of people.

2. Dynamic Representation Technologies in Multimedia Electronic Map

Printed maps have many advantages, for examples they are easy to use and do not require expensive and complex computers and technical skills, at the same time they show many disadvantages also, such as, they can not keep up with the rapid developments of modern technologies and it is very difficult for them to represent the dynamic objects or phenomenon in real word, and so on. It is impossible to overcome these disadvantages in printed maps, so multimedia electronic maps become more and more popular, and many dynamic representation technologies have been used in multimedia electronic maps to represent the dynamic objects or phenomenon in real word and other information. In multimedia electronic map, dynamic representation has two meanings, one for map contents and another for visualization of map contents. The former means in a same view interface, the contents of map alter according to the view scale. When the view scale is zoomed in, the contents of map will become more detailed and the information provided to users will be more. The latter focuses on how to represent current contents with dynamic technologies.

2.1 Dynamic representation for map contents

In multimedia electronic map, map contents will change according to the varying scale. In smaller scale, only some important map objects are shown. With augment of map scale, some other map objects will be added to map in order to represent detailed information. Thus dynamic representation for map contents can, on the one hand, remain information density that benefit reading map, on the other hand, improve the speed of map displaying. In general, two technologies are used to implement dynamic representation for map contents:

- A large-scale database-based

  In this method, one map only has one large-scale database. When the display scale is smaller than it, the automatic generation technologies that are supported by complex data structure and arithmetic will be used to get map objects. Although this method is advanced in theory, it is not used widely in practice because of its complex data

structure, arithmetic and theories.

- Multi databases-based

This method uses multi databases to store map objects in different scale separately, and one database corresponds to one scale view of map. According to the display scope of map and user's customization, different database will be visualized. Because every database has same data structure and no automatic generalization technologies are involved, it is easy to organize data and put this method into practice.

2.2 Dynamic representation for visualization of map contents

Dynamic representation for visualization of map contents is characterized on one hand by effective action, and by audio-visual appearance on the other. They serve two functions. One function is to call the user's attention, and the other function is to depict temporal processes of the real world, or other non-temporal processes. The dynamic representation of map can be implemented with various technologies such as sound, dynamic symbols, animation, virtual reality etc.

- **Sound:** Generally the application of sound in multimedia electronic maps has four main purposes. Firstly it can be integrated to achieve a good atmosphere by playing background music. Secondly it can represent some spatial-related information. For examples in some electronic atlases pointing at a country on a world map would initiate the national anthem or introduction of the particular country, or pointing at a specific object will result in a sound explaining the object. The same approach can be used to explore a country's language and other spatial-related information. Thirdly it can enhance the perception of real world Phenomena. This is the use of sound in phenomena like the noises of rain and thunder, the noise of a busy intersection, etc. This kind of representation will provide additional information in the map. Lastly it is used to give the user prompt of information and to support orientation and navigation. For instance, when the user want to another place from here, the map with tell him how to get there with sound.
- **Dynamic Symbols:** The uses of dynamic symbols can display real world phenomena and attract user's attention. There are four kinds of dynamic symbols: dynamic point symbol, dynamic line symbol, dynamic area symbol and blinking symbol. The dynamic point symbol is used to represent point object or phenomenon of real world, such as a tree or a lighthouse. Its visualization can be achieved through the changing of size, lightness, texture, color hue, orientation, shape and location in space or animation technologies. For example we can use one dynamic point symbol to represent a moving car. Some linear object or phenomenon can be visualized by dynamic line symbol, such rivers. The successive changing of lightness, color hue or texture can be used to put it in practice. In real world, many area objects or phenomenon, such as alteration of land use, are dynamic. It is difficult to represent these changing or alteration using static technologies, so dynamic area symbol can be used. Above three kind of symbols aim at the visual representation of real world, but because of the difficulties of implementation, most of them are not used widely by now. Now

blinking symbol is used widely to locate the identified object or attract the user's attention, and the changing of color, texture or other dynamic elements can make it come true.

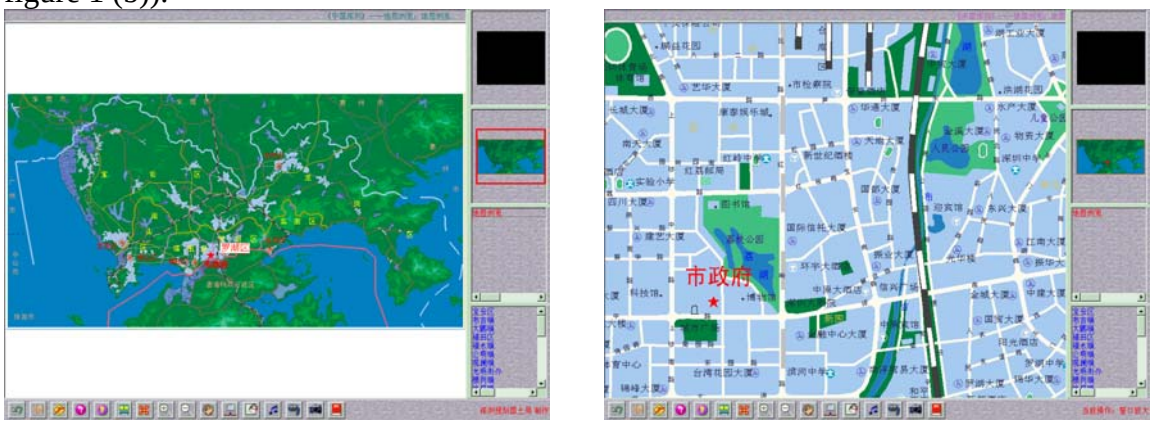
- **Animation Technology:** The animation technology has been used widely in electronic map, and its applications include three aspects mainly: dealing temporal processes, dealing with non-temporal processes and enriching the representation of information or improving interest of reading map. In real world there are many phenomenons that will change with temporal change, such as coastline or city boundary. Their statuses at certain time can be represented statically using several separate map sheets, but it is very difficult to represent their changing processes that are very important to the users. So animation technology can be applied to deal with temporal processes of the locational or attribute components of spatial data. The animation technology is capable of dealing with non-temporal processes. One good example of animation application in this aspect is representation of a three-dimensional landscape. Expect above two aspects, the animation can also be used to give the users other information about identified objects, thus as a video of a city or school, and it is not dealing with temporal or non-temporal processes, but it provides a excellent method to represent information, and at the same time it can enhance the interest of reading map. In general animation can be generated according to two methods: frame-oriented and object-oriented. The former is the most elementary animation method in which each single frame is created separately, and finally all frames are combined into an animation. This kind of animation is created easily, but lacks interaction. The later is currently the most powerful animation, in which the features in real world are abstracted to objects, and the program can control the objects and users can interactive with them.
- **Virtual Reality Technology**: Virtual Reality (VR) uses computers and human-computer interfaces to create the effect of a three-dimensional world containing interactive objects with a strong sense of three-dimensional presence. VR systems are usually designed for the simulation of real world phenomena and provide a variety of interactive 3D computer graphics features for scene navigating and scene access. They enable users to move towards a finer emulation of the complexities of a 3D-scene and can be combined with our perception, cognition, and motor abilities. In thus environment users can interact with the objects using multiple senses, such as touch, sound sensation etc. At the same time Virtual Reality technology can be combined with multimedia technologies to enhance the representation of spatial information.

3. The Applications

3.1 The application of dynamic representation for map contents

Figure 1 shows the application of dynamic representation for map contents. This application is based on two databases. Figure 1 (a) visualizes the smaller scale database that includes some district boundaries, main roads, main rivers, and other important objects. When the display scope is smaller, the larger scale database is visualized (See

figure 1 (b)).



(a) (b)

Figure 1 Dynamic representation for map contents

3.2 The application of dynamic symbols

Figure 2 is an application of combination of electronic map and GPS used in cars, in which the car's position is displayed with a moving symbol on the map. When the car moves, the symbol will move according to the position of the car.

Figure 2 dynamic symbol

Figure 3 Virtual reality

3.3 The application of virtual reality

Figure 3 is one virtual campus that uses virtual reality technology. In virtual campus, the use can navigate and query information of road, building, and other objects.

3.4 The application of animation technology

Figure 4 (a) is one virtual flying of terrain along one certain route in which animation technology is used to dealing with non-temporal processes, and figure 5 (b) is one application of animation technology that enriches the representation of information or improves interest of reading map.

(a) (b)

Figure 4 Applications of animation technologies

4. Conclusions

This paper describes the technologies of dynamic representation in multimedia electronic map in detail, and introduces some practical applications of these technologies. It can be found that the researches and applications of technologies of dynamic representation in multimedia map have gotten better results, but they are at the beginning and it will have a long way to go to put these technologies into practices, at the same time, with the development of technologies and enhancing of user's requirement, the researches will be continued.

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