

VIRTUAL TERRAIN ENVIRONMENT

a New Annotation for Maps and the Cartography

Gao Jun

Department of Cartography, Institute of Surveying and Mapping

66 Longhai Road, Zhengzhou 450052, P.R.China

E-mail:gaoxx@371.net

1. Digital map

The emergence of digital maps is the uppermost reason arousing the change of cartography. We need to look at cartography from a new angle, either in the practice of map production or in the theoretical research of cartography.

A digital map is an assembly of a set of spatial data, which is disperse data with assured coordinates and attribute signs depicting geographical elements and phenomena according to definite geographical framework combined^[1].

Therefore, there is a need for us to introduce a concept of "invisible map".

Digital map is a kind of invisible map (Figure 1).

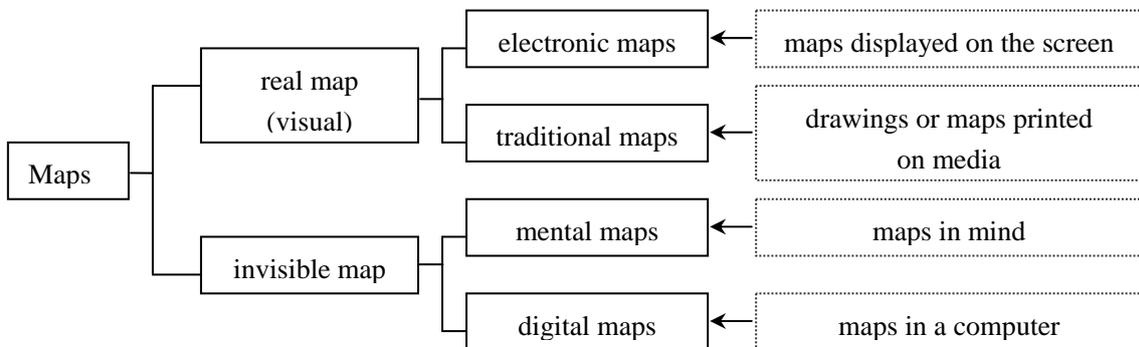


Figure 1

Digital maps foretell a wider field of cartography (Figure 2).

2. A kind of immerseable map

Under the condition of the digital mapping and the network, especially the broadband , a kind of 3-D,dynamic map supported by the Virtual Reality technology is gradually coming into the practical phase. From the technical viewpoint, we may call it a virtual enviroment, a terrain simulation, or a cyberspace^[2]. But from the cartographical viewpoint, it is a new kind of immerseable map.

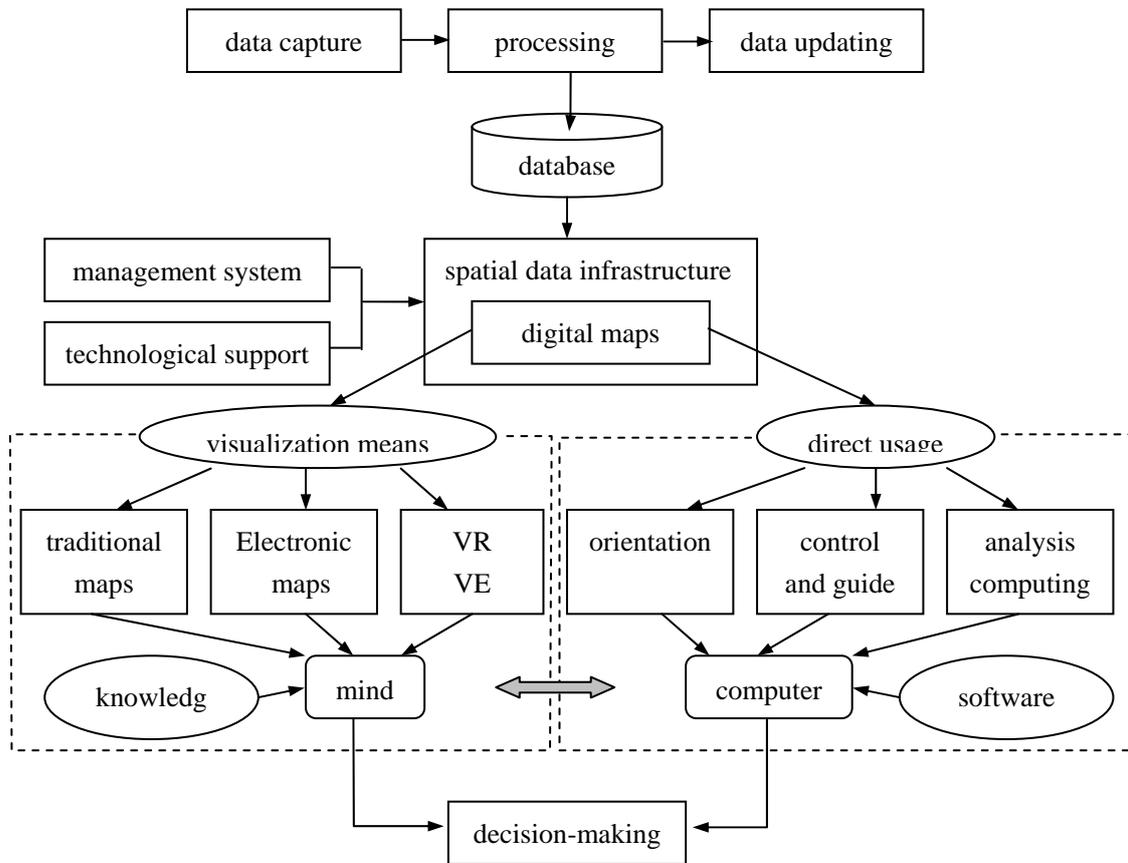


Figure 2

In history, cartographic scholars paid much attention to 3-D representation of the terrains on the maps and never intermitted. From the Mawangdui map(about 200 B.C) to Imhof hillshading, and even to Chen Shupeng’s landscape presentation, they attain a lofty realm of art. In practice, we have to do some auxiliary work such as the quantitative description of the planar map, making the sandtable and city models to intersify the spatial sense of user. So, when the technology of computer achieve a certain level, configurating a new model of reality--virtual environment will be a fair and reasonable extension of maps and cartography.

We started our experimental work in the beginning of nineties last century, for the purpose of cooperating with the application of digital maps, namely, geographical spatial databases.

In contrast to traditional maps and solid maps, we have found some characteristics of virtual terrain environment:

1. There is an accurate 3-D coordinate quantitative basis, which alters the limitation of perspective graphics. As we know perspective graphics is lively but incalculable.

2. Great Changes have taken place to the concept of the scale. In the traditional maps, scales and contents are both solidified. In order to adapt to various purposes, all countries adopts the method of publishing serial scale basic maps to compromise users’ demands. In virtual terrain environment,

there has appeared a case that one scale corresponds to several levels of details, corresponding to resolution, and each detail level can be depicted by several scales. It means that, we have to introduce not only the concept of detail level into the cartography, so as to supply users with a scope in which they can realize optimal selection, but also will renew the traditional principle that the geographical spatial database is classified by scales. We will classify them by resolution or detail levels.

3. A new conception of “Man in the map” have come to the map users’ cognition. Immerseable map layes the user into the virtual environment to watch it. The existence of six-freed-degree body position and view-point will create different images that have different detail levels to fit for, which will solicit some mental and technical problems in theories and practice, such as the technology of LOD data compression^[3].

4. The interactable cartographic environment demands that users should possess all-right mapping knowledge. The maps are no longer the patent products of mapmaker.

5. The virtual environment presents a kind of method or a tool that simulates the things and phenomenon which are not realistic. It will make users experience the real environments in the works, or the catastrophic locale personally. Playing an important role in the improving plans, preventing disasters and alleviating disasters^[4]. The traditional map is a model of reality, but the dynamic virtual environment is the simulation of a course. The presentation of the virtual space introduces the concept of cybermap, which arouses the map scholars’ theoretical interests.

6. Comparing with the use of traditional maps, the virtual terrain environment are more dependent on the hardware, at least now. Besides, it needs a great deal of network technology, and requires a powerful database to support.

With the appearance of Virtual Terrain Environment, there have occurred some new problems that have puzzled cartographers.

The first one is the relationship between cartography and other subjects.

You cannot tell Virtual Terrain Environment should be regarded as the prolongation of cartography or the extension of computer graphics^[5], because both parties have been doing the same task. The dominance of cartography is that the experts in this area have studied it for hundreds of years and have achieved many results, such as the modeling of reality, symbolization of topographic features, especially the humanoid design of graphics. Today, when they are in a new field—Cybermap, which is not only the updating of technique, but also the extension of cognition and the cumulation of knowledge. With the popularization of high-tech, the computer technique will be converted from “professional” into “capacity”, then the dominance of cartography will also stand out.

The secondary issue comes from cartography itself: Is the Virtual Terrain Environment a kind of map? The answer is positive. But many great changes have taken place in cartography. For example, some visualized products from geographic spatial database are replacing the traditional maps, in an ambience of technocrat, they are not regarded as the extension of the assortments or functions of

maps, rather, as a reason of negating traditional map. Again under the digital mapping condition, the ancient mapping mode “who wants it who does it” has occurred again, which is not viewed as a great advance, but something weakening it, and as a reason that regards the cartography as a common skill.

3. Demanding to redefine the map and cartography

The feature of spatial data visualization, which a map has, arouses the recognition of map users and map developers^[8]. Because of the emerging of digital mapping technology, "map maker" and "map user" are combined into one within GIS. And, the mode of dividing the work of mapmaking and map using, which has lasted for two hundred years, has being changed. Map users begin to pay attention to how a map is made.

When the advantage of digital map visualization is attach importance to again, it is found that the cognitive researches and some theoretical conclusions based on two-dimensional mapsformerly have got behind. As dynamic and multi-dimensional maps have appeared along with the development of 3D GIS and a new field of VRGIS has been presented in several years, they need new cognitive research, and the theory and the method of 3D graphics modeling^[9].

Depending on the information technology, a map realizes fleetly the progress from static to dynamic, from 2 dimensions to 2.5 dimensions and up to 3 dimensions, but the lag of basic research disturbs evidently the further development of cartography to the direction of humanoid and intelligentization (Figure 3).

Scientists want to explore an explicable relationship among phases in this process(Figure 4), but now they can not. To resolve these problems, even only a few or one, will bring an important effect on the development of map. The description of this process, of cause, is realized in the combination and the complementarity between human mind and a computer.

What changes in the area of cartography will occur in the development of computer technology? Is the regression of cognitive way (the appearance of electronic maps and micro-display systems)? Or the change of cognitive framework (placing biological CMOS chips in human mind)? Or the dissimilation of human's physiology (the cognitive mechanism changes of human's physiology by bioengineering)? None can be explained clearly at this stage. But in the foreseeable future, there is greater possibility of the regression of cognitive way (the first) happening, because to get knowledge through reading (written language and graphics) is still the most feasible and most effective method decided by physiology.

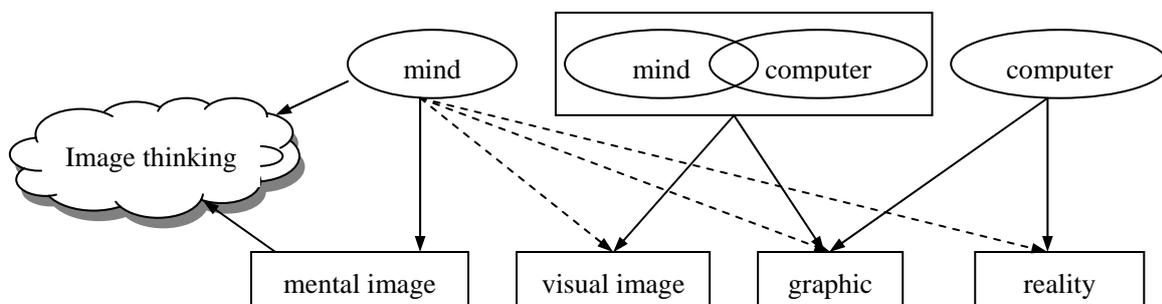


Figure 4

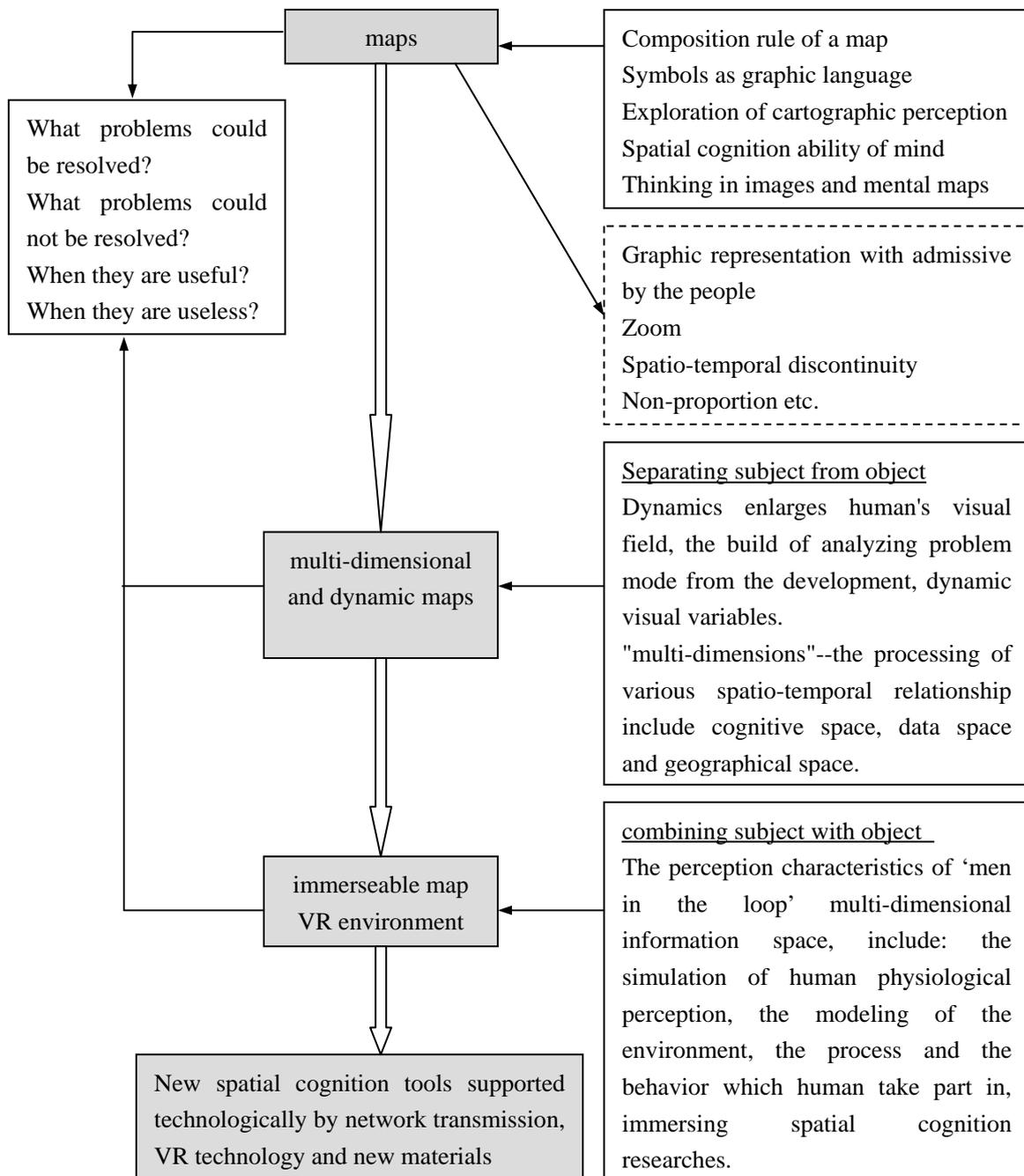


Figure 3

4. Conclusion

We may regard the initial stages of 21st century as the new Enlightenment of cartography. Omnifarious mapping products arouse cartographers to reestimate the functions of map. We could

not live in a world without maps. Once the electronic technology and IT industry are developed into high suitability, a sheet of electronic map can be showed on a folding “paper” screen (the development of this kind of screen has been reported), which will reappear the face of original map.

Map is the interactive achievement between human-being and his existing environment. It is not only the main tool in spatial cognition but also the result of cognizing the world. Its existing can not be confined by technique, however with the development of technology its assortments and functions will be extended and consolidated continually. Therefore, cartography, as a sort of science researches in maps, will be developed unceasingly.

Reference

- [1] Gao Jun, Digital Maps : The Pillar of Geomatics Industry in 21th Century. Bulletin of Surveying and Mapping. Beijing No.10. 1999
- [2] Wang Cheng-wei and others, VR Technology Theory, System Implementation and Application. QingHua University Press. ISBN 7-302-02144-9 1997
- [3] Goldiez B. and others, Real-Time Visual Simulation on PCs. IEEE Computer Graphics and Applications. January/February 1999
- [4] Gong Jian-Hua, Lin Hui, Virtual Geographic Environments. A Geographic Perspective on online Virtual Reality. Higher Education Press. Beijing 2001
- [5] Alan Collinson, Virtual Worlds. The cartographic Journal. Vol. 34,No.2, Dec. 1997
- [6] Gao Jun, Visualization in Geo-Spatial Data. Engineering of Surveying and Mapping. Vol. 9, No. 3,Sep. 2000
- [7] MacEachren A. How Maps Work: Representation, Visualization, and Design. New York. Guilford Press. 1995.
- [8] Jiang Bin & Ormeling F. Mapping Cyberspace: Visualising, Exploring and Analysing Virtual World. 19th International Conference of ICA Proceedings. Ottawa, 1999
- [9] Slocum T.A. Thematic Cartography and Visualization. Prentice hall. 1999