

System implementation of 3D city simulation and planning aided design

- Taking Yinchuan City of Ningxia Hui autonomous region in China as an example

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Abstract: Using remote sensing, virtual reality, three-dimensional GIS, database and other key technologies to merge 3D digital elevation model, satellite orthograph image and 3D stereo model of urban street, building and urban facilities. We reproduce urban architectures and block landscapes to enable user to see idyllic landscape of urban streets very intuitively on display screen. It can perform a series of operation such as roam, measure, query, aero-browse and so on, can meet a visualization demand for digital city technology to develop from two dimensional GIS to three-dimensional virtual reality and can furnish information service of three-dimensional visualization space geography for city construction planning, community service, property management, fire control safety, tour traffic and so on.

Keyword: digital earth, three-dimensional simulation and planning, high-resolution satellite image

0 Introduction

Since Mr. Gore, vice president of United States, presented the concept of “digital earth” in 1998, “digital earth” has already become an important stratagem for West Country to impulse science & technology and economic development. To impulse economic development in our country, various regions and various industries also successively present digital region, digital industry and so on, one of which is “digital city”. By using the high resolution satellite remote sensing images as the main information source, combined with the field inspection numeric photos, the writer of this article and other persons adopt a traditional modeling tool (3DS MAX) to fabricate the model of buildings, carry out the secondary development on the VRMap software platform of Beijing Lingtu Company, with the case of selective typical block, summarize out a flow of fabricating 3D city simulation and planning system based on high resolution satellite image and develop out a suit of universal simulation and planning aided design system for 3D digital city.

1 Technical line

Taking the remote sensing image processing technology and GIS technology as support, by means of the existing image processing software, GIS software, we realized fabrication and acquisition of DEM (digital elevation model) data, remote

sensing image and label information data, realized the fabrication of 3D model data of building, road, street lamp, parterre, pool and other ground objects using the 3D modeling software. By data collection and survey collation of attribute data of ground construction, it carries out an integrative superposition for the above data in VRMap software finally. Via programmed on the basis of this software, the secondary development of user interface and various functional module is completed to connect with attribute data base of buildings and other various ground objects to realize 3D browse, information query, planning and design, specific analysis, 3D flight of route and other functions. Technical line diagram is shown in figure 1.

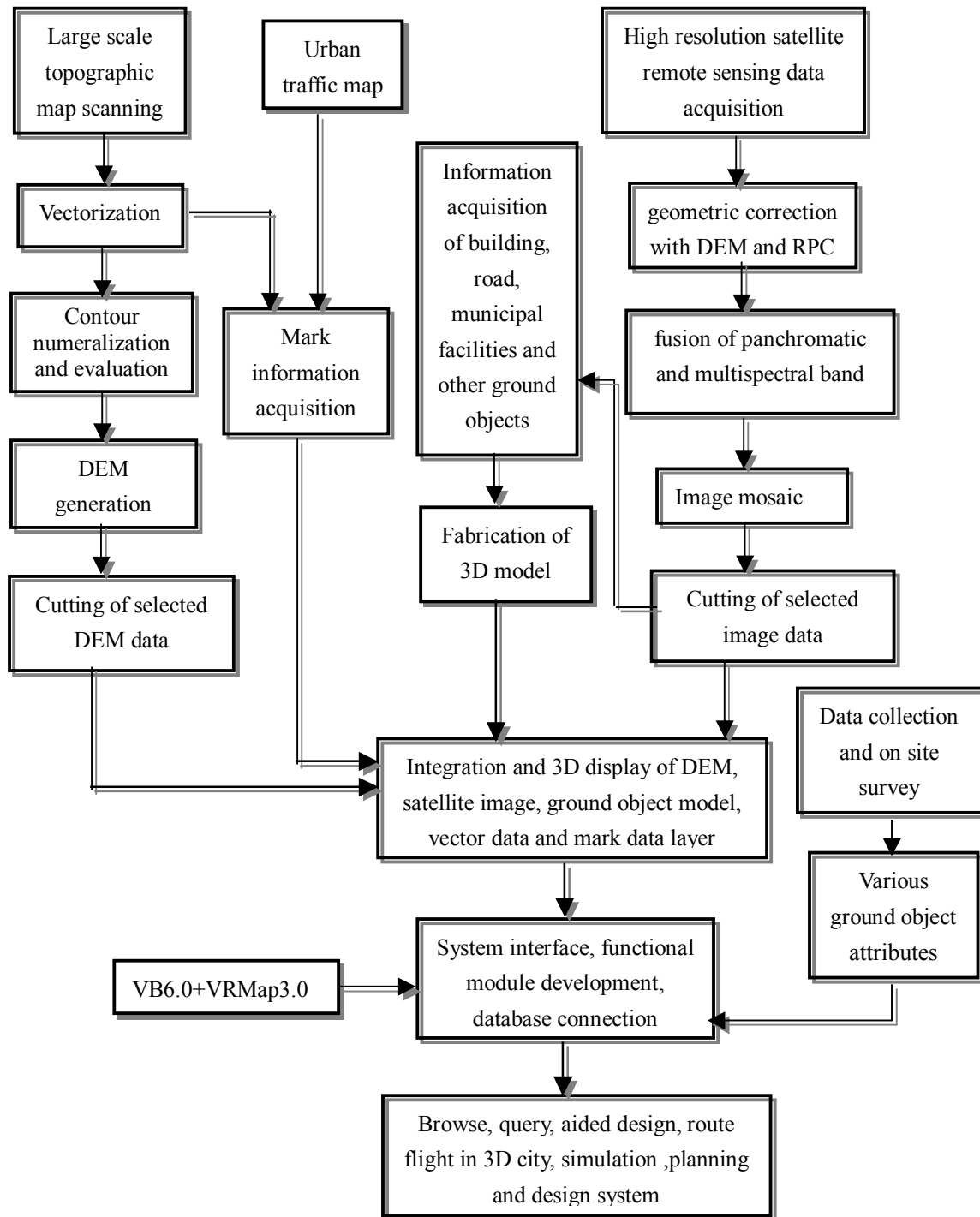


Figure 1 technical line diagram

2 Technology methods

2.1 The application of the high-resolution satellite image

High resolution satellite images mainly provide the spatial geography information for establishment of 3D digital city of typical block, provide exact geographic positions of building, street and other various ground objects and distribution range of space, green area, water body with different overlay type and provide information carrier and foundation for 3D digital city by combining with DEM (digital elevation model). Via fusion of panchromatic and multispectral images, the adoptive American Quickbird data can reach the ground resolution of 0.61 meter, with a drawing scale reachable to plane precision of 1: 2000. It can replace a landform map to be used in the region without a landform map of large scale and has very good present features at the same time. Because the hypsography of most city zone is comparatively flat, the landform map of 1: 10000 can be selected as DEM data source.

2.2 3D fabrications for urban buildings

By using 3DMAX software to carry out 3D modeling of buildings, we changes the numeric photos collected in the field investigation into orthonormal pictures to match material quality pictures for the fabricated model of buildings and generates Simulation model of buildings. Roof texture can be obtained from the true color high-resolution satellite image.

2.3 Integration of satellite orthograph image, digital elevation model and 3D model

The high resolution satellite image, digital elevation model, various fabricated ground object model and road, lawn, space, water body and other 2D vector lines and planes collected from high resolution satellite images corrected by orthograph are integrated and matched to corresponding texture models to generate 3D virtual blocks (Fig. 2).



Figure 2 3D simulation scene

2.4 Establishment of attribute database and connection with 3D simulation system

Sorting and encoding are performed for various 3D model and ground object types of blocks to fabricate respective corresponding attribute database. According to coding,

we realizes the connection of attribute data and model of 3D block to enable user to realize the attribute query for various ground objects in 3D virtual simulation system, and combined with concrete industry application, we realized renewal, analyses and other functions to enable the fabricated 3D block model to serve for every walk of life of national production.

2.5 Research and development of 3D city simulation and planning aided design system

By using VRMap3.0 software platform of Beijing Lingtu Company and performing the secondary development under Visual Basic 6.0 Chinese version, we developed out a suite of 3D digital city simulation and planning aided design system which can perform browse and design of 3D block scene roam of large data quantity. It can also carry out design of model of buildings, traffic roads, electricity power lines and import of external data. It can import the fabricated house and other 3D models as well as tree and other transparent pictures and append the text label. It can import 2D line and plane and match texture model to generate 3D landscape and carry out toponym and objective search, measurement of distance, excavated volume of area and so on. Meanwhile, after setting corresponding attribute database, in roam and browse process it can query attribute information of various ground objects (road, house, power line and so on). At the same time it also has the renewal, statistical analysis and other functions of 3D virtual block and attributes data and can furnish intuitionistic and high efficient design and management tool for urban planning management, property, traffic, police fire control and other departments.

3 System application in city planning and design

3D city planning is a development trend of planning industry. Along with ceaseless development of computer graphics technology, people continually attempt and look for a variety of 3D graphics technology suitable for their profession. Because it is more intuitionistic than a planform and can express more for most purposes such as rationality of construction and cultural facilities, on the consideration for a variety of surrounding combined environment and other aspects, it is more persuasive than plane data, 3D technology application will be a trend in the recent years. In the present universal 3D technology, 3D virtual simulation is no doubt a rising applied technology with very large predominance.

Adopting virtual reality technology, based on 3D geo-information platform, to carry out virtual field fabrication, can import local area planning data to carry out the scheme evaluation, And it can use systemic GIS analyses function, attribute data management, the secondary development support, vector data support and skin skeleton technology to realize various data management and specific analysis and furnish the gist for visualization decision support.

Using intuitionistic, accurate, whole angle analyses and comparison means furnished by system can enhance scientificness of planning and decision-making. It can enhance urban construction quality and promote urban to develop with persistence that 3D technology is utilized fully to carry out virtual design of city planning

reconstruction and in virtual planning scene, mobile and multi-angle comparison is carried out for the planning building and landscape to ascertain optimal design after comprehensive consideration of environment, surrounding structural relation, building design and other manifold factors.

4 Conclusions

It will affirmatively impulse further develop of digital urban construction and have broad market application prospects to apply the 3D city simulation and planning aided design system which is fabricated on the basis of high resolution satellite remote sensing image to 3D city planning and to carry out various city information management, query and analyses by combining database technology at the same time.

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