

EXPERIENCE AND IMPLEMENT FLOW OF VIRTUAL FIELD ARCHAEOLOGICAL ENVIRONMENT

Yang Lin^{a, *}, Sheng Ye-hua^b

^aKey Lab. of Virtual Geographical Environment, Ministry of Education, Nanjing Normal University, Nanjing 210046, China - yangcius@126.com

^bKey Lab. of Virtual Geographical Environment, Ministry of Education, Nanjing Normal University, Nanjing 210046, China - shengyehua@njnu.edu.cn

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ABSTRACT:

Virtual field archaeological environment involves many key technologies and implement flow, which mainly includes acquiring automatically and quickly multi-resource spatial data and building data models and three-dimensional body visualization and network cooperative interactive-working and building knowledge base and models base for field archaeological digging and decision-making and so on. In the last two years, the author had some relative research and experience on archaeological data management based on Geographical Information System (GIS) involving spatial data acquisition, three-dimensional GIS visualization, cultural site analysis and estimation. Concretely, the author studied on: ① acquiring quickly field archaeological spatial data, which includes data obtaining based on close-range digital photogrammetry by digital camera, with which the archaeological mapping and three-dimensional data by projection from two-dimensional plane image maps all could be implemented and get, and data acquisition for large site scene based on three-dimensional laser scanner; ② proposing the general data model of field archaeology—hybrid 3D spatial data model based on facial model and volumetric model according to the classification of stratum and geographical object; ③ fusion and visualization of multi-resource data for field archaeological spatial data; ④ human being and historical evolvement for region archaeology with the spatial and attribute data in different periods based on spatial analysis; ⑤ data mining based on spatial and attribute database with the relative arithmetic such as support vector machine, genetic algorithms, fuzzy clustering, fuzzy reasoning etc.; ⑥ archaeological data management system based on GIS, which took the example of cultural relics along the Eastern Route Project of South-to-North Water Diversion and so on. All the above researches and experience not only transformed the traditional mode of the mapping data capture in field archaeology, but also decreased greatly the workload of the work on the premise of enough accuracy, realizing the transformation from manual mode to computer-aided and information management and heightening the efficiency in data capture and processing and mapping and management, which is a good base for information search of relics and the simulation and recurrence of archaeological environment and spatial analysis and decision-making. This article sums up the work in the last years and puts forward the framework and implement flow of virtual field archaeological environment based on the integration of the basic work available and the presentation of not only static objects, such as tombs, but also dynamic processes, for instance sites migration and wireless working model which allows multi-users to operate the same work from geographically distributed places collaboratively and spatial decision-making and support system etc.. The main flow is as following: In the phase of the presentation and simulation of static objects and dynamic processes, building and integrating the multi-resource data such as raster data and vector data, and data models based on database technology on a uniform platform. Especially solve structure of data storage and 3D body visualization and the management and interaction of multi-resource data models. Established the virtual archaeology geography environment based on LAN and wireless LAN by synthesizing the production of Web GIS and three-dimensional GIS technique available as well as the international standard of distributed interactive technique. The aim is to aid the study and research between field archaeology workers in different areas, and to provide a new environment for long-distance expert consultation. The main key techniques of the contents are the research and implement on cooperation work, long-distance supervise and expert consultation technique as well as the study of integration and multi-manipulation of virtual archaeological environment system. In the phase of the spatial decision-making and supporting, the knowledge base and rule base could be built based on the archaeological knowledge. At the same time, including the research on archaeological excavation and the digging mechanism of time-space data, and the research on construction of the colony decision-making intelligence and the mechanism of interact-working and so on. We can also save all of the intercommunion of the experts through internet, what's more analyzed and dig the knowledge of the experts. Then add all the digging knowledge into knowledge base to enrich and improve the content, consequently enhance the intelligence level of the spatial decision-making and supporting system. The main target of this study is to combine field archaeology spot with relevant cultural relic protection organizations and function branches, science & research organizations by means of LAN & wireless LAN as a whole one, so as to establish and adjust important excavation projects, and solve problems occurred at the field excavation spot, and increase the quality and level of the field work by using the information of archaeology relic and experts' knowledge on the scientific environment and platform. And at the same time it makes the simulated ancient circumstance more manipulable and be personally on the scene for the common visitors and audiences. As the

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* Corresponding author: Yang Lin, email: yangcius@126.com

current research base and the development of virtual geographical environment, the design of implement flow of virtual field archaeological environment proves feasible.

1. INTRODUCE

As the most important and direct approach to acquire the first-hand archaeological data, field archaeology ensured the research on archaeology. However, some defaults always existed in the indagation and protection during the process: excavating according to former experience in a closed environment, the acquisition of the field data was based on ordinary and simple surveying, the data were recorded in a 2D (2 dimensions) method such as paper map and picture, which went against the information sharing.

As an integration of geography, surveying, mapping and computing, Geo-informatics technology is a good tool providing people collection and management and analysis of spatial information. The key technology GIS had been applied widely to many fields e.g., E-government, city planning and project management and so on. In the latest several years, GIS began to be applied to archaeology in information management and data acquisition and spatial analysis, and getting some improvement.

Although, there was few application of geographical information technology in field archaeology in China, while only commonly focused on the applying of some technique in defect of systemic researching platform for field archaeology. So, the author researched on building the virtual field archaeology environment involving the data integration, 3D visualization, knowledge base, data sharing and decision-making, which would increase the working efficiency and level and provide a potent researching platform for field archaeology. It is significative for advancing the level and modernization of the protection of cultural relic.

The article mainly includes the general researching framework and finished work and the next researching conceiving and planning.

2. GENERAL FRAMEWORK

The general researching framework of virtual field archaeology environment involved two important parts: the data integration and knowledge base. The framework shows as the following figure 1.

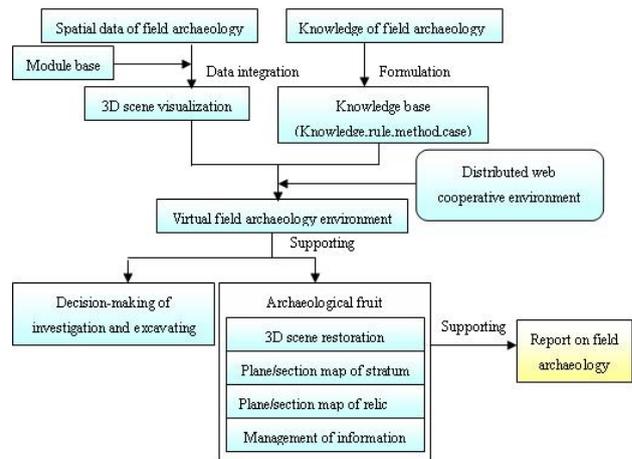


Figure 1. General researching framework and flow of virtual field archaeology environment

3. ACHIEVEMENTS

3.1 Acquisition automatically and quickly of spatial data based on digital photogrammetry

The author had implemented a method of applying digital photogrammetry to field archaeology mapping by calibrating the images achieved by digital camera to the orthophotos which were used to directly get kinds of plot maps. The method could not only transformed the traditional mode of the mapping data capture in field archaeology, but also decreased greatly the workload of the work on the premise of enough accuracy, realizing the transformation from manual mode to computer-aided and information management and heightening the efficiency in data capture and processing and mapping and management, which was a good base for information search of relics and the simulation and recurrence of archaeological environment and spatial analysis and decision.

3.2 Spatial data model for field archaeology

As we all know, data model is the core and key of GIS as well as the basis of all functions implement. The author studied 3D data acquisition and data model and implement in field archaeology.

The focal points of this study included mainly:

- (1)General modelling: put forward the general data model of field archaeology GIS(FAGIS)——hybrid 3D spatial data model based on facial model and volumetric model.
- (2)Object-oriented modelling: Design and expound the two models on the basis of the demand, character, method of model, logical model and data structure, which were described with hybrid model of facial model and volumetric model. The integration method and steps of the stratum model and geographical object model, and modelling method and relative technology also were discussed and completed.
- (3)Implement: based on DEMs and QTPV and TIN and TEN, the integration method of the stratum model and geographical object model of field archaeology had been built and instantiated partially.

4. THE NEXT RESEARCHING CONCEIVING AND PLANNING

4.1 Spatial data integration of field archaeology

Orienting the phase and time sequence of field archaeology, shape of vestige and researching region, the relative integration methods would be studied which involving kinds of special means on archaeological grading from field investigation to plot digging (single one to multi-plot) then to single site and to multi-site. All the above research is based on the integration of digging data and basic geological data. The research includes concretely: The edit and update of data on time sequence of field archaeology; data integration for a whole vestige; building an integrative environment by the update and integration continually for a bigger archaeological scene, namely, considering the field archaeological knowledge and integrating the new excavated scenes for building a bigger archaeological scene in a uniform spatial reference frame, and the bigger scene is useful for the more macroscopically analysis for archaeologists.

At the same time, studying the integration of multi-resource and different-construct data orienting 3D scene restoration based on multi-factor of archaeological data class and internal relation and knowledge and rules and so on.

4.2 Knowledge base of field archaeology

The knowledge relevant to field archaeology includes other relative subjects (for example, geology and folklore), common and peculiar rules in different regions and environment (for example, plain archaeology and desert archaeology), concrete archaeological means and principles and especial cases and so on. By analyzing, integrating and concluding the experience and knowledge during the field archaeology and standardize and formalize them (the knowledge shows as data, text, graphic, image video and audio and so on), build responding knowledge base of field archaeology based on knowledge base models fitting to describe and represent them. The comparative integrated knowledge system for field archaeology would be built from part to whole by continual improvement and integration, which assist the archaeologist in excavation and decision-making.

4.3 3D scene modelling of field archaeology

Research on the modelling method of 3D facial models for spatial objects involving multi-resource data: rapid 3D facial restoration with discrete data based on feature-constraint and model base; 3D texture projection method and level-of-detail model in different scales; emphasis on the restoration of single stratum scene and the whole scene; ultimately by automatically mosaic and integration of the models, modelling and visualizing the underground and groundbased and overground relic, building the digital scene supporting the spatial analysis (measurable and supporting query and statistic) for intuitionistic and full-scale analyzing the spatial distribution of the vestiges .

4.4 Decision-making

Research on the platform for excavation and decision-making of field archaeology in a distributed web cooperative framework: establishment of database (model spatial-database and knowledge attribute-base), basic platform for visualization, functions customization of space representation and analysis, in addition, building an integrative and uniform platform on which

users could cooperate to work in an internet & wireless-lan communicating environment.

5. CONCLUSIONS

The implement of virtual field archaeology environment involves many key techniques, which are the emphasis of the author resolving. The available achievement had proved in increasing the field working efficiency and level, and the implement of virtual field archaeology environment was sure to provide a potent researching platform for field archaeology.

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MS. Zhou Jie-yu. Key Lab. of Virtual Geographical Environment, Ministry of Education, Nanjing Normal University