Application of WebGIS Technology in Information Management of Agricultural Science and Technology Park

Chun Li¹, Guoqi Lou¹, Jianwei Ma¹ and Lu Yang²*

¹Yunnan Kunming Taiwan Farmer Pioneer Park Administrated Committee, Kunming, China
²College of Information Science & Engineering, Yunnan University, 650500 Kunming, China

ABSTRACT

WebGIS has many advantages such as widely recognition, abundant users, platform crossing, low average cost and easy to use for the final users. Now, it has been widely used in all walks of life. This paper introduced the WebGIS technology first, and then introduced the functions of the "Kunming Shilin Taiwan farmers entrepreneurial park" information platform and the way to realize these functions. Finally we use WebGIS technology to develop the geographic information visualization platform based on ArcGIS and realize the visual management function of the park-based infrastructure (including enterprises, roads, pumping stations, water storage Pool, water supply pipes, video monitoring points and other geo-features) based on map. For now, the platform has been in operation for the management of "Kunming Shilin Taiwan Farmer Pioneering Park".

INTRODUCTION

Since the 1970s, foreign researchers have applied GIS (Geographic Information System) [1] in land resource survey, land resource evaluation and agricultural resource information analysis. In recent years, with the development of network technology, people began to combine WEB technology with GIS technology to form WebGIS technology. It provides geographical operation and analysis to customers through open channels, breaks the limitations between regions and the compatibility between the computer platform and achieves a cross-regional and cross-platform geographical operation and analysis. Agricultural Science and Technology Park refers to a certain area of modern agricultural science and technology enterprises, which aims at adjust the agricultural structure, relies on the modern agricultural technology. It opened up a new way for the transformation of traditional agriculture in China with its "high technology, high standards and high efficiency". There is a large number of information under procession among the construction and production management, and mainly are geographic information, such as the park's terrain, land use, soil type, water supply and drainage data. All of the data have strong regional and spatial characteristics. The application of WebGIS technology in the visual management of agricultural science and technology park can realize the visualization of the park's geographic information smoothly, improve the management level of the park, promote the development of cutting-edge agricultural technology, and more widely and more effectively serve the agricultural management, Park managers manage the park in a more intuitive way. At
present, WebGIS has been used by many researchers in the agricultural field, G Modica, X Liu and other researchers have applied WebGIS to analyze terraces [2], assess crops [3], prevent crop diseases [4], control agricultural pollution [5] and design the farming system [6]. However, WebGIS is less used in the field of agricultural irrigation, and now we will use WebGIS to develop a visualization system that can manage the park’s water supply lines and agricultural irrigation.

MATERIAL AND METHODS

WebGIS is a combination of Web technology and traditional GIS. With the global, low cost, high efficiency and openness of Web technology, WebGIS is widely used in all walks of life and allows geographic information systems to enter the ordinary people’s daily life. The basic architecture of WebGIS is shown in Figure 1.

![WebGIS basic architecture diagram.](image)

Similar to Web applications, the basic workflow for WebGIS is that users use the Web client (typically a browser) to send HTTP (HyperText Transfer Protocol) requests to the Web server. The Web server forwards requests for GIS functionality to the GIS server, the GIS server reads the required data from the GIS database, processes the request, and then returns the data, map, or other operation results to the client via an HTTP response display. WebGIS server is the most important part of the WebGIS architecture. A modern, complete WebGIS server must at least provide the release and processing of maps to support interoperability, fast performance, robust scalability and highly customizable functionality between different vendors’ products at the Web service level. A geodatabase is a collection of data about a certain geographic feature in a region. It can store different types of geographic data, such as vector data (points, lines and polygons) and raster data (satellite and aerial imagery). Geographic database is the foundation of WebGIS application support. The value of a WebGIS application often depends on the quality of its data. The client plays two roles in the WebGIS application: on the one hand, it represents the final user interface of the entire system, and be responsible for interacting with the user such as collecting user input, sending a request to the server, and displaying the results to the user. On the other hand, the client, especially the fat client, can also run some spatial analysis tasks, such as the dynamic classification of geographic features to make thematic maps, clustering over-intensive points, and interpolating dot-like information to generate heat map and so on.

We use ArcGIS products which is design by ESRI (Environmental Systems Research Institute Inc.) to design system. ESRI is a world famous GIS software vendor, its GIS software provides a systematic and complete GIS solution for the power,
telecommunications, transportation, environmental protection, planning, land, natural resources, national defense, public security, aerospace, commercial and other fields, and has become a number of local government departments to manage geographic information standards. This paper uses ESRI's ArcGIS Server to realize Web-based campus geographic information visualization management and analysis. ArcGIS Server is ESRI's Web Map Server product, which represents the cutting-edge development of today's WebGIS technology and enables developers and system designers to implement a centrally managed GIS. A single, centrally managed GIS application (web application) can reduce development costs, support multiple users, and reduce the cost of installing and managing desktop applications on client machines.

![Map GPS positioning and coordinate acquisition.](image)

Figure 2. Map GPS positioning and coordinate acquisition.

Every researcher needs data as a basis material when creating an information platform, as in the paper [7] the author collects heavy metal data. Park space and attribute data is the basis of information platform, all the functions of information platform must have accurate and reliable basic data support. Therefore, it is necessary to collect, verify and process the park's existing related business and basic data to obtain comprehensive, accurate and reliable basic data. Manage enterprises in park is the main management content of the park management committee. Before the implementation of this project, the land area and the boundary of the enterprises are not carried out professional system mapping, but to take extensive estimates to manage, which can not achieve fine management for land rent and payment. In view of above problems, this project uses RTK (real-time dynamic difference) GPS technology and high-precision professional GPS surveying and mapping equipment to finish the park-related space and attribute data collection, acquisition, verification and processing. Including geospatial coordinates of the 17 main enterprise land, public land, and land boundary in 13,000 acres core area of the park (Including 1284 parcel boundary points), as well as the park road, water supply pipelines, pumping stations, reservoirs, water points, video monitoring points of space and attribute information of the field surveying and processing industry. The GPS positioning accuracy reach centimeters level, the function of map GPS positioning and coordinate acquisition is shown in Figure 2.
Geometric cross method is used to compute the area and perimeter of the plot under the jurisdiction of 1.3 million mu of core area based on ArcGIS platform.

The project platform uses a new generation of object-oriented spatial data model-GeoDatabase as a smart campus integrated information platform spatial data model. The model uses standard relational database technology to express the data model of geographic information, and integrates spatial data and attribute data into the standard relational database in the background to realize the seamless integration of spatial data and attribute data. It is an intelligent spatial data model based on RDBMS (Relational Database Management System). GeoDatabase uses object-oriented technology to abstract the real world into feature classes (points, lines, faces) that contain spatial information and object classes (feature attributes) that do not contain spatial information. Each feature class and object class has attributes, behaviors and rules, and the elements are associated with objects such as relational classes, geometric networks, and so on. Construction process of spatial database is shown in Figure 3.

This paper designs and establishes reasonable spatial data element class, object class and relation class based on the new generation object-oriented spatial database model-Geodatabase, and designs efficient, stable, safe and practical agricultural science and technology park information management space database.

Wisdom Park Integrated Information Platform Geodatabase is a collection of geographic feature data sets, object classes, and relational classes in accordance with certain models and rules. That is, the spatial database of the agricultural science and Technology Park organizes the geographic data according to the hierarchical data objects, including the Feature Dataset, the Feature Class and the Object Class.

In order to make the database structure clear and easy to design, development and maintenance management, the intelligent database is divided into the following layers:
basic data, park roads, park buildings, water supply lines, water supply pipelines, pumping stations, water storage pool, soil moisture monitoring points, water level monitoring points. Among them, the basic data layer within the range of the park area are high-precision remote satellite images.

In spatial database of the wisdom park, the feature data set is a collection of feature class of the shared space reference system. In the spatial database, all feature classes in the same geographic feature dataset must have the same spatial reference, that is, the coordinate system, the spatial domain, and the precision are the same. Spatial reference is an important part of database design. Agricultural Science and Technology Park spatial database built in Microsoft SQL Server 2008 SDE database, achieve the creation of spatial database process through ArcCatalog. The spatial database layers are shown in Figure 4.

![Spatial Database Layer Structure](image)

**Figure 4. Spatial Database Layer Structure.**

**RESULTS**

The GIS-based geographic information visualization management platform designed based on 3S (Geographical information System, Remote Sensing, Global Positioning System) technology to realize the map-based campus infrastructure’s (mainly including park enterprises, plots, park roads, pumping stations, reservoirs, water supply lines and video monitoring points) visual management. Its main functions include: display for high-precision remote sensing image map of the park, park information space query and browsing, park enterprise visualization management, park block visual management, park road visualization query and management, park water supply pipeline visual query and management, park pumping station visualization query and management, park cistern visualization and management, park video monitoring point visualization management, map measurement (length, area, perimeter), map GPS positioning, thematic map production and map export and others.

**CONCLUSIONS**

This paper uses WebGIS technology to design the comprehensive information platform of the wisdom park of Shilin Taiwan Farmer Pioneering Park. It not only realized the function of visual management like paper [9] and [10], but also realized the function of monitoring and positioning the park water supply lines, reservoirs and other facilities. Breaking the use of traditional management approach to the limitations of the system and implementing remote, interactive access to a more intuitive way to manage
Pioneer Park. Through the development of the system, the platform realizes the modernization of resource and environment information management of the park and meets the requirement for the entire park information query, retrieval, extraction and application form each department. Meanwhile, the platform also achieves the rapid update of the park resources and environmental information, which has improved the efficiency for departments and visitors to obtain the park information and achieve the park information resources online sharing and services.

REFERENCES