The Research of the Cloud GIS Platform of Intelligent Tea Gardens in the Plateau Mountain—Take the Tea Gardens in Jiuang of Guiyang City an Example

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Abstract. To promote the informationalization and intelligentization managing of tea gardens in plateau mountain, the research builds the cloud GIS platform of Intelligent tea gardens with a mixed model of C/S and B/S, synthetically using many technologies such as the 3S technology, the network technology, the cloud computing and the big data mining of spatiotemporal information. The purpose can provides services of mass data support, intelligent analysis of remoting sensing, environmental intelligent assessment, decision support and innovation, for the producing and managing departments of tea, the decision-making and business units, scientific research institutions and the general public. The result can provides certain reference for the construction of the informatization of tea gardens and the integration of tea garden and tourism.

1. Introduction

Guizhou is dominated by the terrain of plateau mountainous, with high altitude, low latitude and less sunshine. It is suitable for the growth of tea. It becomes one of the important producing areas of tea industry. Tea gardens of Guizhou mostly distribute in mountainous areas, with high disparities in landforms and large differences in microclimate [1]. In addition, the producing technology and the managing method fall behind, resulting in some problems such as the difficult of environmental monitoring, the lagging information resource, and the hidden safety of tea [2]. The tea industry becomes shortcoming for the development of modern agriculture in Guizhou. It is imperative to promote modernization and intelligent development of the tea gardens. With the arrival of the era of big data, High technologies represented by the 3S technology, the POI database technology, the cloud computing and the big data mining of spatiotemporal information are emerging [3]. These high technologies can provide a stable technical support for the construction of the informatization of tea gardens and the integration of tea garden and tourism.

Currently, scholars at home and abroad conduct extensive researches on the production, management, storage, and monitor and early warning of tea gardens, using different high and new technologies such as the producing and managing system of tea gardens based on the SSH2 framework [4], the comprehensive management system based on the J2EE framework [5], the automatic monitoring and managing tea gardens’ system based on the 3S framework [6], the fertilization system based on the object-oriented framework [7], the pest’s warning system based on...
the WebGIS framework and so on [8-10]. In summary, scholars are more inclined to establish broad and systematic intelligent systems of tea gardens, which are lack of regional and targeted issues. The cloud GIS platform of intelligent tea gardens in the plateau mountainous is mainly aimed at the special landform and fragile ecological environment in Guizhou Province. It is regional, local and pertinent, which provides certain reference for the informational construction of tea gardens in the plateau mountain.

2. Methods

2.1. The massive data acquisition and process of tea gardens
Due to the fact that tea gardens in Guizhou mostly distribute in mountainous areas, with high disparities in landforms and large differences in microclimate. In addition, the signal in tea gardens is weak and the layout is scattered. It is easy to form blind spots for collection and monitor, and is extremely difficult to collect and monitor tea data. In order to solve above problem, it is necessary to use BDS technology to build a highly accurate, comprehensive and real-time data acquisition and monitoring model. Due to the complexity of basic data types and huge capacity of Guizhou tea gardens, data storage and management are extremely inconvenient [11-12]. Based on the cloud storage architecture, basic tea garden data, special application data, remote sensing images, environmental quality models, and POI three-dimensional models are stored in a spatial data management database, which realize data share, data maintenance, data security and data effective management.

2.2. The informational database design and sharing GIS service of tea gardens
The informational database design of tea gardens adopts spatial-temporal framework, the stored and retrieval technology. The spatial vector data, spatial attribute data, text data, remote sensing image, static and dynamic data are multi-sourced. This database not only provides convenient, timely, and accurate information for the managing platform of tea gardens, but also directly relates to whether the various parts can be tightly integrated and how they can be combined with each other. Due to the huge amount of statistical analysis of tea garden in plateau mountainous regions, the traditional model's ability to reuse models and process cross-platform data is low, resulting in some difficulties which realizing efficient spatial statistical analysis and innovative application services. Therefore, aiming at above problems, the system builds a GIS resource pool which realizing resources share, providing infrastructure resources and creating platform sites.

3. overall design and main function
The system integrates technologies such as cloud computing, parallel computing, POI database, and network cluster. It uses Service-Oriented Architecture (SOA), Open Geospatial Consortium (OGC) standard services and mix C/S and B/S to design a GIS platform that support multi-platform deployment, multi-application. The overall platform is divided into four layers: application layer, service layer, data layer, and cloud infrastructure layer. The overall architecture is shown in figure 1.
3.1. Overall design

The application layer is mainly for users. Users use laptop, desktop, workstation, and mobile APP to access and understand tea garden layout, planting area, tea variety, growing trend, plant disease and insect pest etc. The main application includes the meteorological monitoring of tea gardens, the soil environmental quality assessing, tea growth monitoring, and pest and disease monitoring. The service layer mainly includes the evaluating model for environmental quality of tea gardens. The platform encapsulates models into service components and application programs for assessment of soil heavy metal contaminant and atmospheric pollutant, evaluation of soil nutrient and the evaluation of tea garden’s suitability. At the same time, service interfaces for environmental quality assessing models are constructed. Business units or scientific research institutions can upload or download environmental quality assessing models of tea garden to the platform.

The data layer mainly provides data support for the cloud GIS platform of the tea garden in the plateau mountain. The data content mainly includes vector data, raster data, and attribute data. The vector data includes the geographic data, the topographic data, and the soil sampling data, which are from the Tea Quality Inspection Center and field monitor in Guizhou. The raster data comes from the geospatial data cloud platform (http://www.gscloud.cn) of the Chinese Academy of Sciences. The attribute data includes tea gardens’ producing and managing data, weather data, soil fertility data and so on. The cloud infrastructure layer provides the general software platform resources for the production and management of intelligent tea gardens in the mountainous regions. Through the establishment of a remote sensing cloud platform based on cloud computing technology, various resources (hardware, platform, software, data, service, etc.) will be integrated to provide On-demand services for data processing in intelligent tea gardens. Through cloud stored technology, the efficiency of remote sensing data storage and process in intelligent tea gardens has been improved.

Figure 1. The system organization chart
3.2. Main function
Taking the tea garden in Jiuan Town, Guiyang City, Guizhou Province as an example, this research builds the cloud GIS platform of intelligent tea gardens. It realizes some functions such as efficient collection of tea garden data and storage of cloud architecture, intelligent remote sensing analysis and management, environmental intelligent assessment, and traceability of visual trace. This functional structure diagram are as figure 2.

![Figure 2. The system process chart](chart)

The collection information of the tea garden data mainly includes spatial data and attribute data such as basic tea garden information, soil nutrient, and soil heavy metal contaminant. For different types of information, the collection methods adopted are different [13]. For tea garden plot and ditch adopt geometry acquisition method. For soil nutrient, soil heavy metal pollutant, meteorological data adopt spatial sampling point acquisition method. For tea garden infrastructure adopts POI data collection method. It can be used to improve the precision, rapidity, and accuracy of tea garden data acquisition. Based on the cloud storage architecture, basic tea garden data, special application data, remote sensing image, environmental quality model, and POI three-dimensional model are stored in a spatial data management library, which effectively integrate management and data share, data maintenance as well as data security.

The data intelligent analysis mainly includes the interannual variation and spatial distribution of meteorological factor, soil heavy metal pollutant, and soil nutrient etc. The system uses spatial and temporal analysis of meteorological factor to select suitable crops for planting, and realizes rational irrigation and fertilization of crops, prevention of pests and diseases, and early warning of disasters. Through the soil heavy metal pollution and soil nutrient analysis, the spatial distribution of soil environmental quality in tea garden is visually displayed. It provides scientific support for tea garden management and decision-making. The data intelligent management can realizes basic GIS functions, including map load, map display, map zoom, map roam, and two-way query of tea gardens graphic information.
The environmental intelligent assessment that based on the spatial database, model library of environmental factor and user need can evaluate factors such as atmospheric, soil pollution, soil nutrient, etc. The evaluation results are mainly spatial thematic maps. The soil environmental quality of tea garden is demonstrated by color rendering. The spatial distribution provides scientific support for tea garden management and decision-making. The visual traceability function is collecting and analyzing tea plantation data through BDS technology and realizing early warning of diseases and pests. Taking the evaluation of the environmental quality of the tea garden as an example, the picture three shows the evaluating result of arsenic in soil pollutant. The green area in the figure three indicates that the soil arsenic content meets the national soil safety standards for arsenic in the tea garden. The Jiuan tea garden is in a totally non-polluting state.

![Figure 3. The map of the soil quality of intelligent tea gardens in the plateau](image)

4. Conclusion
Taking modern efficient tea gardens in Jiuan Township as an example, this research analyzes the key technical problem and propose a solution for the cloud platform based on the cloud computing environment. The platform offers users some services such as reliable data collection and storage, intelligent remote sensing analysis and management, environmental intelligent assessment, visual traceability. Through the establishment of the intelligent cloud GIS platform of tea gardens in the plateau, the tea garden information resources, technical resources and intellectual resources will be integrated to provide services in a scaled, intensive construction approach, reducing tea garden remote sensing data, technology and service cost, and promoting the socialization of the cloud platform of intelligent tea garden. This study promotes the development for the construction of the informatization and the integration of tea garden and tourism.

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