Construction of High-standard Farmland Geographic Information System

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Abstract. At present, the management of high-standard farmland is only managed at the county level, and data reporting is done by the county in the form of reports, which cannot form a unified data sharing model, resulting in low efficiency in daily management. The comprehensive management system of high-standard farmland designed in the thesis can completely solve the problem of non-uniform management and provide a comprehensive management, query and statistical summary platform with unified data and intuitive image.

1. Introduction

For a long time, agricultural management departments at all levels have been insisting on stabilizing food and strengthening agriculture, strengthening the construction of new agricultural modernization, and promoting the coordinated scientific development of "three cultures" as the primary task of agricultural construction. In the new situation, combined with the construction of the core area of grain production, the construction project of high-standard farmland "100 million" is implemented [1]. Due to the wide range of data involved in provincial high-standard farmland [2-3], the provincial agricultural departments lack a unified and intuitive comprehensive management, query and statistical summary platform for the data of high-standard farmland in each city, county and district. Based on the above background, the system builds a unified geographic information database and business index database based on provincial, municipal and county high-standard farmland by using WebGIS technology and mobile GIS technology to realize data query and statistical summary of various types of high-standard farmland in the province, and to load data into mobile electronic devices such as tablet PCs and large-screen cell phones. The provincial office staff can realize information query function and field verification function, as well as business office and other auxiliary decision-making function at any time and place. The goal of the system is consistent with the new requirements of "unified resource management, flexible and efficient office" of the provincial agricultural departments under the new situation. After the system is put into use, it can improve the efficiency of high-standard farmland data management, it can improve the management level with a new working mode, and it can transform the office mode. It can grasp all kinds of high-standard farmland information comprehensive platform in real time and dynamic.
2. High-standard Farmland System Architecture Design

According to the system function design, business logic control and data storage, the system architecture is divided into function display layer, business logic layer and data support layer, and the system architecture is shown in Figure 1.

![System Architecture Diagram](image)

(1) Data Layer

The data layer realizes the data storage and some configurations of the system, the data storage is used to realize all the storage of the system data table, the data storage is realized through the database platform, Microsoft SQL Server 2008 is used as the database platform in this system. The data layer can receive data operation instructions and return operation results, receive data operation instructions mainly to run SQL statements, in the interface provided by the database platform through the execution of standard query statements, the execution of SQL statements, in addition to the need to return the corresponding query data set or update the implementation status of the instructions, etc..

(2) Business logic layer

The business logic layer organizes the data provided by the data layer according to the rules of one, forms the association of data, and expresses it in the shape of functional logic, and the business layer is generally limited to the definition of business logic. The business logic layer in this system includes permission setting, query setting, data audit setting and data export setting. Permission setting is used to set different operation rights of provincial agricultural department, municipal agricultural department and county agricultural department to the system; query setting is used to set the display mode of system data query and data statistics; data audit setting is used to set the data relationship between municipal and county level by logging in user code. Data export setting is used to set the setting of export function of data query results.

(3) Function display layer

The display layer mainly shows the system function operation interface and the interaction layer between the system and the user. Through the representation layer, the user can input data and the result of the system processing is displayed in the interface, the display layer includes the management of farmland projects, data reporting and auditing, mobile terminal and data statistics, the display layer is the operation interface of each function.

3. System Network Structure Design

System users include agricultural departments at provincial, municipal and county levels. Agricultural departments at all levels are connected to the central server through PC terminal, browser, and in
addition, county and municipal agricultural departments are connected to mobile terminal through mobile terminal to realize mobile terminal operation. The system network structure design is shown in Figure 2.

Figure 2. System Network Structure

4. System function planning

4.1. Farmland project management function
High-quality farmland project is the county-level agricultural departments through the client to enter the various types of high-quality farmland project information (including 10,000 mu square, 1,000 mu square and 100 mu square) in the region, through the system to report the data to the corresponding municipal agricultural departments, the municipal agricultural departments to the county-level data reported by their respective data to check the reasonableness of the data, if it is consistent with the actual situation, then submit and save to the system database, then the provincial agricultural departments to The data reported by municipalities are queried and counted. Farmland project data involve wells, ditches, field roads, bridges and culverts, table areas, forest networks and other related data parameters, and specific data include construction content and construction projects, where construction content includes wells, ditches, roads, bridges and culverts, irrigation and drainage power support rate, and forest network coverage rate; construction projects include construction department, construction year and investment amount[4]. In addition to basic information, farmland projects also need to provide farmland site construction photos, basic information in addition to this information, but also through the system to achieve the uploading of pictures, upload pictures based on jpg format, can reflect the well, ditch, field roads, bridges and culverts, table areas, forest network data information of the site photo photos. Farmland project management includes functions such as square field information maintenance, regional station information maintenance, square field information query and regional station information query. Figure 3 shows the screenshot of the operation of high-quality farmland GIS.
4.2. Mobile terminal function
With the development of mobile Internet technology, the informationization of various industries is changing to mobile platform, and the mobile terminal based on tablet PC provides a flexible technical platform for data query and data statistics by providing simple and convenient operation methods. Mobile terminal functions include GIS general functions, square field data query, regional station data query, field positioning, and project statistics.

4.3. Data statistics function
Data statistics function is for different user roles, respectively, the statistics of the high standard farmland projects in their areas, through the statistical results to understand the current construction status and investment status of high standard farmland at the provincial level, each city and each county. The statistical functions include provincial summary statistics, statistics by city and statistics by county.

(1) Provincial summary statistics: Detailed statistics on provincial high-standard farmland projects from the provincial level, including the planned area of high-standard farmland, the area that has been built in each year and the area that has not been built yet, etc.

(2) Statistics by municipality: Provincial users can provide detailed statistics on the planned area of high-standard farmland, the area that has been built in each year and the area that has not yet been built at present for each municipality at the provincial level, while municipal units can go through the statistics of various construction indicators of their own municipality.

(3) Statistics by county: Municipal users can make detailed statistics on the planned area of high-standard farmland, the area that has been built in each year and the area that has not yet been built in each county under the jurisdiction of the city by taking the county level as the unit, and at the same time, the county level units can make statistics on various construction indicators of their own counties.

5. System development route
This paper studies the management of high-standard farmland based on geographic information, that is, the development of the corresponding functional modules on the geographic information platform. In the design of the whole system, in addition to completing the design of the functional modules of the system, it is also necessary to build the project geographic information database, and the main
technical route of the system geographic information platform applied to the management of high-standard farmland is shown in Figure 4.

Figure 4. Technical route of geographic information application to farmland project management

1) Geodatabase construction

General GIS platform, geodatabase is the basis of the system, so geodatabase construction is an important aspect of this paper's research, the geodatabase construction of this platform is completed through ArcGIS editing platform, and the entry of the basic geodatabase of the project is completed on ArcGIS platform, including vector data and image database, image data is acquired by means of UAV or public map images, and the vector database is realized by digitization operation [5].

2) Construction of attribute database

After the geographic database construction is completed, the corresponding attribute database needs to be entered, and the attribute database construction is designed with the classification of project distribution, farmland project type and project investment, etc. First, the conceptual model of the database is completed, the core tables included in the database are divided, and then each field of the core table of the database is designed, including the storage name of the field, field type and primary key foreign key, etc.

3) Binding of geographic database and attribute database

After the geodatabase and attribute database of the system are established, it is necessary to bind the geodatabase and attribute database, i.e., each geodatabase record of the system achieves a unique correspondence with the attribute database record, which needs to be realized by tool software to achieve the correspondence between them in the map editing environment [6].

4) Functional analysis of the project management GIS

Analyze what functions are included in the GIS involved in this system, in this system, GIS functions include project location information positioning, project geographic location query and statistics, and project scope determination and other functions, where the project location information positioning to achieve the query project geographic location on the map, project geographic location statistics that is to box the way to achieve a geographic distribution area within a project distribution project management GIS functional analysis of the situation, the results are displayed in the form of a list.

5) Functional design of project management GIS

After the analysis of the project management GIS function, through the WebGIS platform to achieve the design of the GIS function framework, the system WebGIS platform using map services to achieve, so the GIS function of the system, by calling the map service interface to achieve, that is, in the background to publish the map service access service, in the client through HTML5 to achieve the call map access interface to achieve.

6) Detailed design of project management GIS

After the overall design of the system is completed, Visio is used to do a detailed design of each function of the system, and through the class diagram and timing diagram to show the business of the
system, so as to complete the entire detailed design, mainly to complete the WebGIS map service interface calls.

(7) Project management GIS function implementation
After the design is completed, the geographic information is adopted as the geographic information platform, and the program is completed through Java on this basis.

(8) Deployment and testing with other functions
In the system GIS function development is completed, the need to integrate the overall functions of the system in the client side, integration mode that is in the general business functions and GIS function of UI integration.

6. Summary
The geographic information management system for high quality farmland studied in the thesis establishes a unified geographic information database for high quality farmland in provincial agricultural departments; realizes the classification and summary of high quality farmland at provincial level by administrative districts such as cities and counties, and each city and county maintains the data in its own area within the authorization, and realizes the field survey, data collection, target field location of high quality farmland through 3G/4G mobile network. The target field location, statistical summary of various index data of provincial high-quality farmland on the mobile platform, to achieve on-site statistics and reporting work.

References
[1] Dong Chunyan. Prospect of national agricultural and rural geographic information service platform construction[J]. China Agricultural Information, 2018, 30(05): 110-117.
[2] Sun Zheng, Wang Di, Zhonggeji. Geographic information extraction of farmland based on OpenStreetMap data[J]. China Agricultural Information, 2018, 30(03): 83-91.
[3] Ye Kefeng, Qiu Xiaochun, Chen Yuxin. Application of geographic national census data in the delineation of basic farmland[J]. Geospatial Information, 2017, 15(08): 15-17+9.
[4] Yan Y, Sun W.P.. An introduction to the application of geographic information system on farmland water conservancy[J]. Electronic World, 2017, 4(15): 191.
[5] Zhao G, Li L, Zhong C-Y. Theory and practice of agricultural GIS construction in Dalian[J]. China Agricultural Information, 2015, 4(01): 155-156.
[6] Zhang Yun. Application of geographic information system in farmland water conservancy [J]. Science and Technology Wind, 2011, 4(20): 94.