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Retraction

Retracted: Design and Application of Land Resource Management System Based on Internet of Things

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Q. Song, "Design and Application of Land Resource Management System Based on Internet of Things," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2726673, 14 pages, 2022.

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Research Article

Design and Application of Land Resource Management System Based on Internet of Things

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In order to further solve the problems existing in the process of land resource management of relevant departments of land and resource management, realize the information management of land resources, and promote the efficient utilization of land resources and scientific information management, this paper proposes a land resource management system based on Internet of things technology. With the help of resource allocation and management algorithm based on the needs of Internet of things users and land resource management requirements, this paper constructs a land resource management system based on Web and mobile network platform. The system development takes Java as the background programming language, constructs the database based on Oracle 9i, and uses GIS/GPS and other electronic map functions to realize the accurate display and resource sharing of land resource information. In the system test, 60, 120, 240, and 360 concurrent users are simulated to access the system at the same time. The connection success rates of the corresponding system are 97.2%, 97.5%, 98.3%, and 96.6%, respectively, which fully verifies the good performance of the system; it can be widely used in land resource information management.

1. Introduction

Land resource is an important basic guarantee resource of a country and region, which can provide a strong basic guarantee for the economic development of a country and region. At the same time, on the premise of providing people with the necessary material basis for production and life, the use of land has also attracted much attention. For a long time, as a large agricultural country with a land area of 9.6 million square kilometers, we have always attached great importance to land management. With the rapid development of information technology, relevant departments have also begun to actively carry out information construction. The system uses the application of information technology to strengthen the protection of land resources and the scientific management of land resources [1]. As the land and resource departments pay more and more attention to the acceleration of information construction, some information systems related to land resource management have also appeared one after another. However, at present, there are still some problems in the existing system and information development direction, such as untimely data update and inconvenient query, in terms of land resource information retrieval and project change, which also hinders the scientific development, management, and application of land resources [2]. Therefore, we must strengthen the application of land resource management technology and further improve the efficiency of land resource management with the help of information technology such as the Internet of things.

2. Literature Review

Foreign countries are widely used in the field of information technology. They have been involved in the application of GIS for a long time and have developed a series of software platforms to provide developers with use, so as to improve the development and application of GIS. As early as the 1990s, they have begun to provide GIS information for office staff [3]. Mobile GIS was initially applied in outdoor data collection and gradually developed and applied to today's mobile positioning system, real-time navigation system,

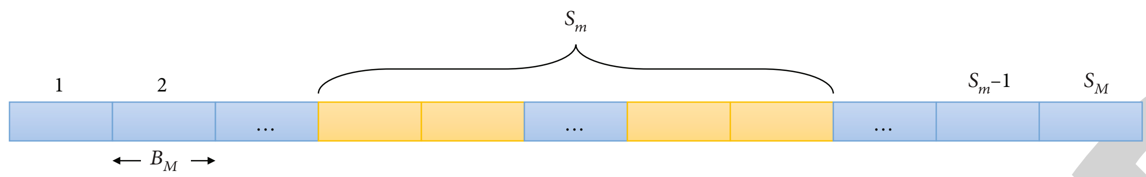

FIGURE 1: Subchannel allocation.

location-based information service (LBS), and other aspects, with great success [4]. Autodesk onsite launched by a foreign company is a mobile service solution. It provides a comprehensive set of tools for mobile terminal development. With these tools, developers can provide perfect technical implementation for mobile development and complete synchronous or offline processing in data processing [5]. If you cannot connect to the network, you can work offline to ensure that the data can be submitted centrally after the user is connected to the network. Onsite provides rich functions: navigation, zooming, and zooming to the selected figure; feature selection and viewing; display symbols in proportion; hot connect to database report; add labels to relevant contents; pop up feature labels; and support color and monochrome display. There are more than 800 kinds of arbitrary coordinate representation diagrams, support standard data format, reliable and compressed data transmission, etc. MapX Mobile launched by some companies is a MapX platform that can be used in Pocket PC [6]. It can be developed and used as a third-party plug-in in the software system and can be well applied to the software development process of computer and mobile terminal. MapX Mobile is a natural extension of MapX and MapXtreme for Windows, through which Windows programmers can develop mobile software [7]. Similarly, Chinese experts and scholars, especially some university researchers, are also studying the GIS on mobile devices with the help of various means. With the help of data collection and processing in the experimental area, some scholars have realized the collection and management of land information on Trimble GeoXT Mobile GIS equipment. At the same time, they can update the land information in time and realize the submeter precision processing of land information through the differential processing method [8]. Through the analysis, it can be seen that the research results play a great role in China's land information collection and management. It can be popularized and used in China's land information collection and research. Some scholars put forward the Ninghai County Land Information Management System based on mobile GIS. The system completes the comprehensive statistical analysis of the land situation of Ninghai County through the comprehensive use of electronic map technology and mobile positioning technology, which makes the land management mode realize the information transformation. The system can complete the services such as land positioning, information viewing, and information query and realize the concept of providing services for land information [9].

3. Algorithm of User Demand Resource Allocation and Management System Based on Internet of Things

3.1. System Model. This section mainly describes a broadband IoT communication scenario using in-band deployment, in which only a single base station is deployed. Make the MTC welcome you according to the NB-bT standard, and all MTCES share a PRB bandwidth for uplink data transmission [10]. The MTCES in single base station NB-IoT network are divided into two types: delay-sensitive equipment and non-delay-sensitive equipment. The two types of equipment are randomly deployed in the network.

Suppose the number of DS devices in the network system is M, the number of non-DS devices is U, and the DS devices are expressed as

$$M = \{m_1, \cdots, m_M\}. \quad (1)$$

The number of non-DS equipment is

$$U = \{u_1, \cdots, u_U\}. \quad (2)$$

Each DS device has a data packet that needs to be uploaded to the base station, and it is required to fully upload the task within the specified delay. The upload task of DS device is expressed as

$$\{p_m, d_m, t_m^{\max}\}, \quad (3)$$

where p_m represents the transmission power of the DS device, d_m represents the packet size uploaded by the DS device to the base station, $t_m^{\max}$ represents the minimum delay requirement of the device, and the maximum value of $t_m^{\max}$ will not exceed $T_{\max}$. On the contrary, non-DS equipment only requires data packets to be successfully uploaded to the base station without delay requirements, which can be described as $\{p_u, d_u\}, u \in U$, where p_u represents the power of the transmission equipment and d_u represents the size of data packets to be uploaded by the equipment [11]. Next, we will focus on the system modeling in this scenario, that is, communication model and subcarrier allocation model.

(1) Communication model

It is shown in Figures 1 and 2.

The resource allocation method of DS equipment is to jointly allocate time slot resources and spectrum resources.

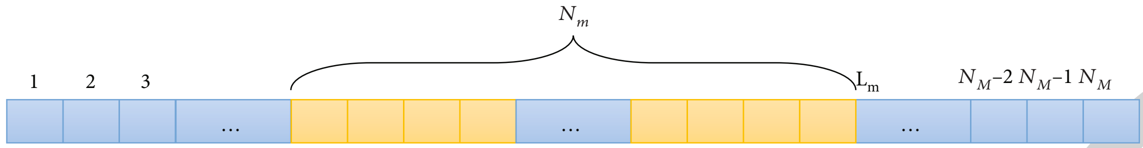

Figure 2: Time slot allocation.

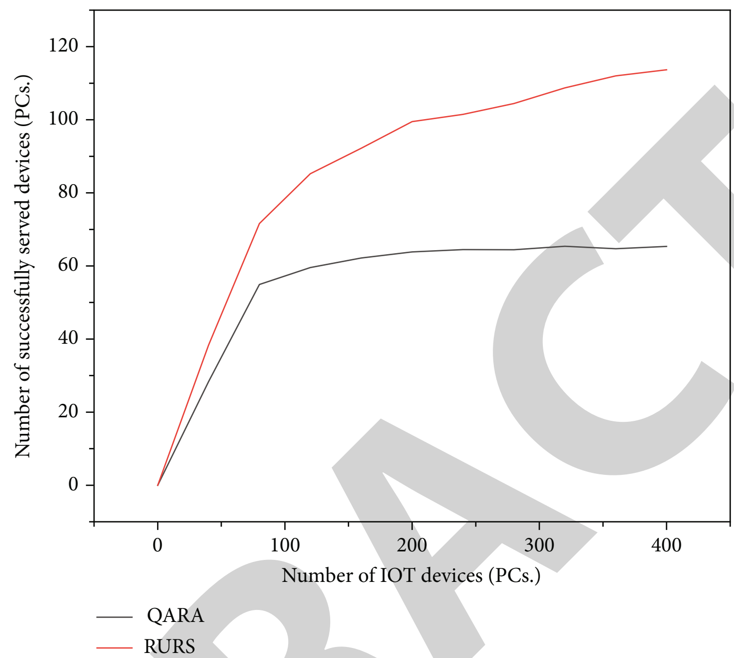

Figure 3: Variation curve of the number of successful service devices with the total number of devices.

Spectrum resources and time slot resources are allocated continuously, as shown in Figures 1 and 2. Based on the allocated number of subcarriers S_m, the uplink transmission rate r_m obtained by DS device m can be expressed as

$$r_m = S_m B_M \log_2\left(1 + \frac{|h_m|^2 p_m}{S_m B_m N_o}\right), \quad \forall_m \in M, \tag{4}$$

where S_m represents the subcarrier bandwidth of the system, N_o represents the noise power spectral density, and h_m represents the channel gain with the base station due to factors such as propagation and fading [12]. According to the time slot resource N_m allocated to the device by the system, the amount of data that the DS device can upload to the base station can be expressed as

$$D_m = r_m N_m T_{\text{slot}}, \quad \forall_m \in M, \tag{5}$$

where T_{slot} represents the size of a single time slot.

According to the time slot and spectrum resources allocated by the system to DS device m, the minimum transmission amount D_m that m can complete can be calculated. The data transmission amount should be greater than the data packet uploaded by DS device, that is,

$$D_m \geq d_m, \quad \forall_m \in M. \tag{6}$$

Meanwhile, the data uploading process of DS device m must meet its own delay requirements, as shown in the following formula:

$$L_m T_{\text{slot}} \leq t_m^{\max}, \quad \forall_m \in M, \tag{7}$$

where L_m represents the time slot position for completing the data packet upload. The following content mainly introduces the communication model of non-DS device u. According to the number S_u of NB-IoT network subcarriers allocated to u, the uplink rate obtained by device u can be expressed as

$$r_u = S_u B_U \log_2\left(1 + \frac{|h_u|^2 p_u}{B_u N_o}\right), \quad \forall_u \in U, \tag{8}$$

where B_U represents the subcarrier bandwidth of the non-DS device and h_u represents the channel gain between the non-DS device u and the base station due to factors such as propagation and fading [13]. Through the number of allocated time slots N_u, the amount of data D_u transmitted by device u can be obtained, which can be expressed as

$$D_u = r_u N_u T_{\text{slot}}, \quad \forall_u \in U. \tag{9}$$

Since non-DS equipment only requires to upload data

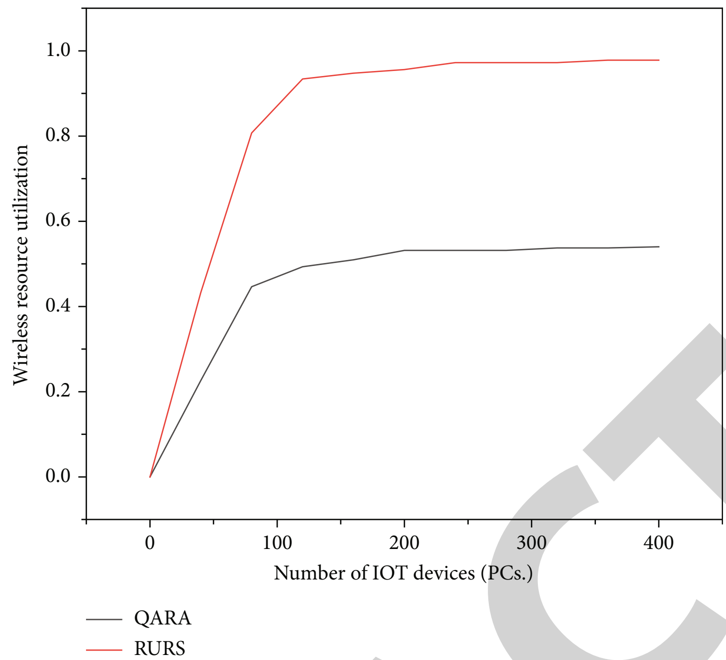

Figure 4: Variation curve of resource utilization rate with the total number of equipment.

packets, the amount of data that can be uploaded D_u should exceed the uploaded data packets of non-DS equipment, that is, d_u:

$$D_u \geq d_u, \quad \forall_u \in U. \tag{10}$$

(2) Subcarrier allocation model

For the resource allocation algorithm of non-DS equipment, the available spectrum resources of the system are divided into S_U subcarriers, and the subcarrier bandwidth is expressed as B_U. According to the difference between DS and non-DS devices, the total time slot resource is divided into two parts, which are denoted as and respectively [14]. The constraints between N_M and N_U are as follows:

$$N_M + N_U = N. \tag{11}$$

The model stipulates that a single time slot under the same subcarrier can only be allocated to a single DS device or a single non-DS device. This restriction is as follows:

$$\begin{aligned} &\sum_{m \in M} o_{s,n,m} \leq 1, \quad s = 1, \cdots, S_M, n = 1, \cdots, N_M, \\ &\sum_{u \in U} p_{s,n,u} \leq 1, \quad s = 1, \cdots, S_U, n = 1, \cdots, N_U. \end{aligned} \tag{12}$$

According to NB-IoT standard, it has the following constraints on subcarrier bandwidth selection and subcarrier allocation. The uplink transmission bandwidth of NB-IoT system is 180 kHz and supports the interval between two subcarriers, which is expressed as set $B = \{3.75\,\text{kHz}, 15\,\text{kHz}\}$. When the subcarrier is 3.75 kHz, the system only supports single-carrier transmission, while when the subcarrier is 15 kHz, the system supports both single-carrier transmission and multicarrier transmission [15]. According to the above situation, the constraints can be obtained:

$$B_M, B_U \in B. \tag{13}$$

In addition, NB-IoT standard imposes constraints on subcarrier allocation, especially for multicarrier transmission. In the multicarrier transmission mode, the standard stipulates that a single device can be allocated 1, 3, 6, or 12 consecutive subcarriers, represented by set $C = \{1, 3, 6, 12\}$. Thus, the subcarrier allocation constraints of the device are as follows:

$$\begin{aligned} &S_m \in C, \quad \forall_m \in M, \\ &S_u \in C, \quad \forall_u \in U. \end{aligned} \tag{14}$$

3.2. Algorithm Design and Implementation. The main idea of this algorithm is to decompose the above problem into two subproblems: DS device resource algorithm and non-DS device resource allocation algorithm [16]. It is assumed that the devices are randomly deployed within the coverage of the base station, and the number of non-DS devices is greater than that of DS devices. The total time slot resources are divided into two parts according to the proportion of the two devices, which can be expressed as

$$N_M = \begin{cases} N_1, & N_1 \leq N_2, \\ N_2, & N_1 > N_2, \end{cases} \tag{15}$$

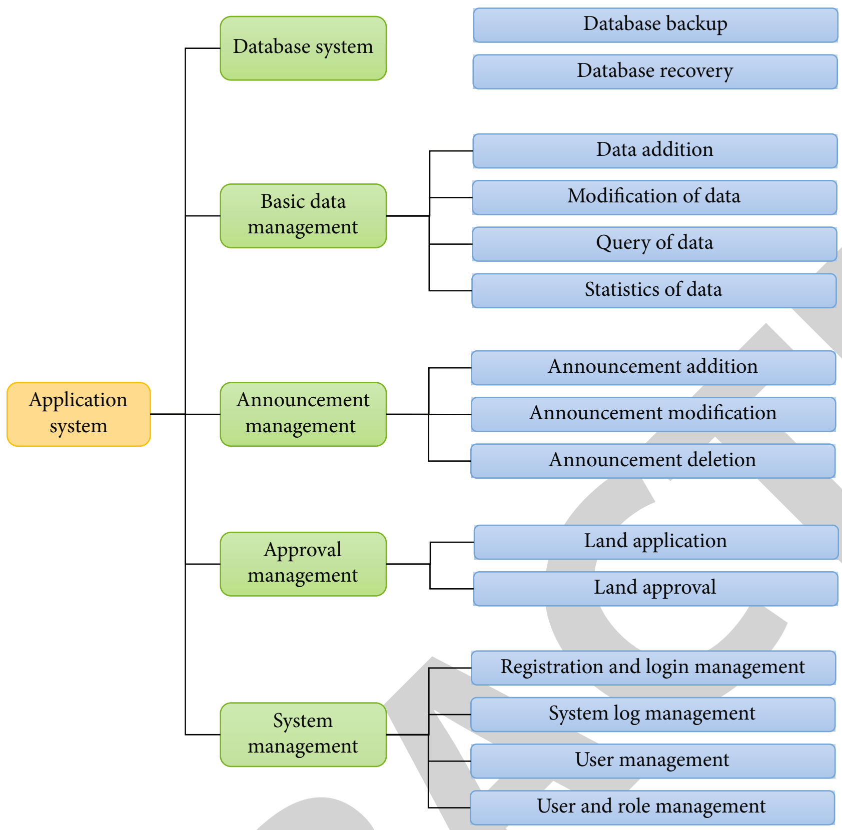

Figure 5: Function module diagram.

where

$$N_1 = \left[\frac{T_{\max}}{T_{\text{slot}}}\right], \qquad N_2 = \left[N \times \frac{U}{U+M}\right]. \tag{16}$$

In the whole algorithm, due to the delay demand of DS equipment, the front part of the overall time slot resources is allocated to DS equipment, and the remaining time slot resources are allocated to non-DS equipment. Considering the effectiveness and rationality of overall resource allocation, these two parts of resources adopt different resource allocation algorithms [17]: the first half adopts dynamic continuous multicarrier allocation algorithm, and the second half adopts single-carrier proportional fair allocation algorithm.

3.3. Algorithm Simulation Results. Figure 3 shows the curve of the number of devices successfully served by NB-IoT system with the total number of devices. In the process of simulation, it is assumed that the ratio of non-DS to DS equipment is 1 : 1, and the number distribution interval of equipment is [0400]. It can be seen from the figure that the curve of RURS algorithm first increases linearly; then, the growth rate slows down, and finally, the curve converges. And then, the number of service devices requested in the network gradually tends to the capacity of the system. Therefore, the curve increases slowly. When the number of service devices requested by the system is much greater than the system capacity, the limitation of system wireless resources leads to the stability of RURS curve [18]. The reason for the linear growth of RURS algorithm curve is that the available wireless resources of the system are greater than the resources requested by the overall equipment, and then, the number of service devices requested in the network gradually tends to the capacity of the system. Therefore, the curve increases slowly. When the number of service devices requested by the system is much greater than the system capacity, the limitation of system wireless resources leads to the stability of RURS curve. The curve trend of QARA

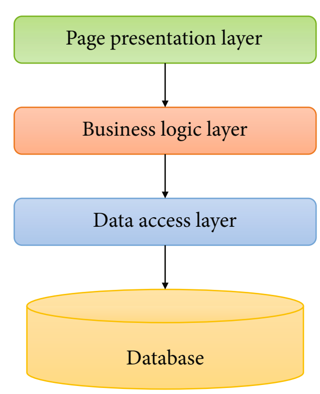

Figure 6: Architecture design of land resource management system.

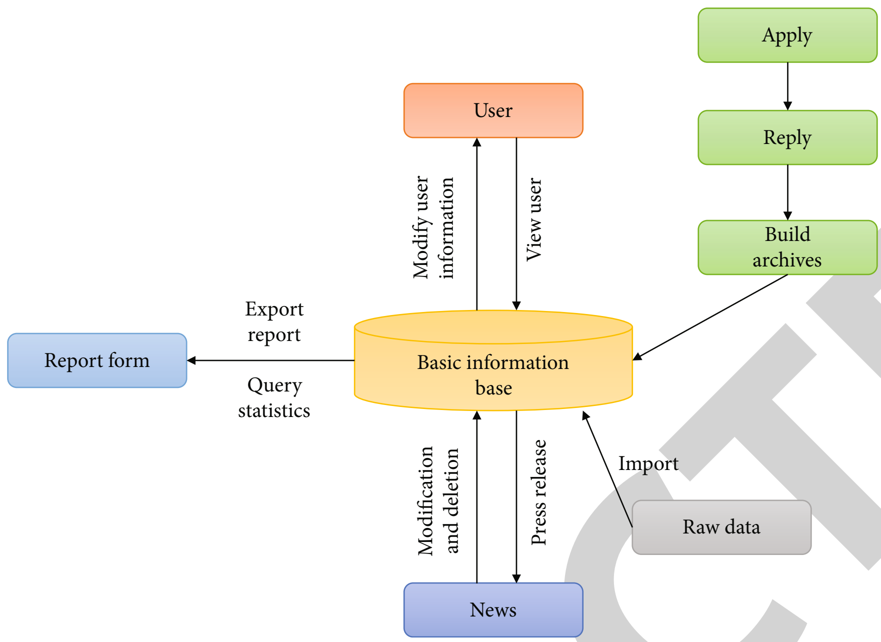

Figure 7: System data flow chart.

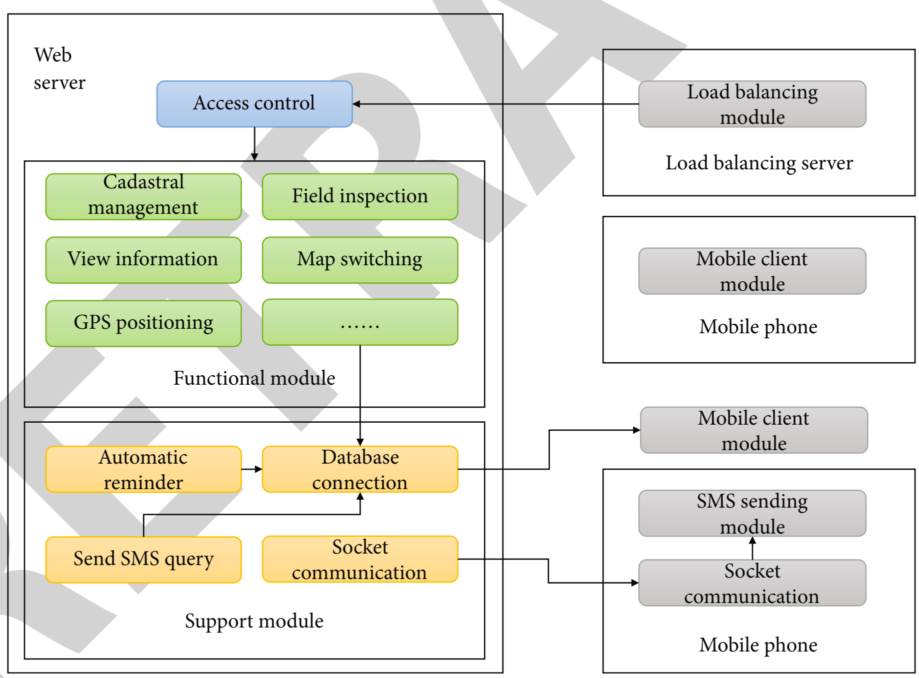

Figure 8: System logic structure diagram.

algorithm is also linear first, and then, the growth rate slows down, but the curve of QARA does not tend to be stable in the end but grows at an extremely slow rate. To a certain extent, low QoS devices are easy to meet the demand. With the gradual increase of randomly generated low QoS devices, the number of successful service devices increases very slowly under the condition of equal resources [19]. Finally, the reason why the curve does not tend to be stable is that due to the proportional fairness algorithm based on system capacity, to a certain extent, low QoS devices are easy to meet the demand. With the gradual increase of randomly generated low QoS devices, the number of successful service devices increases very slowly under the condition of equal resources. By comparing the curves of RURS algorithm and QARA algorithm, it can be seen that QARA algorithm performs better than RURS algorithm in terms of the performance index of the number of successful service devices of the system, and QARA algorithm is nearly 80% higher than

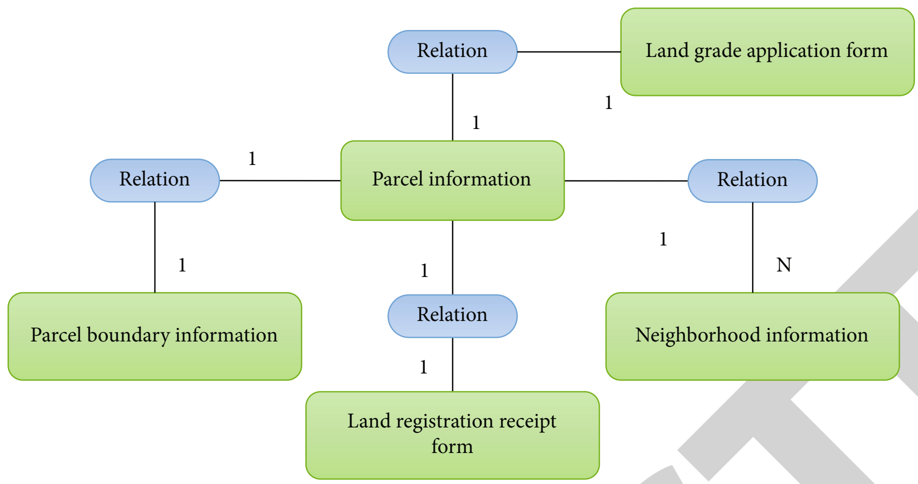

FIGURE 9: System E-R diagram.

RURS algorithm when the algorithms are close to convergence.

Figure 4 shows the change curve of system wireless resource utilization with the total number of system equipment. In the process of simulation, it is assumed that the ratio of non-DS to DS equipment is 1 : 1, and the number distribution interval of equipment is [0400]. The growth rate of RUQRS algorithm is linear, and then, the growth rate of RUQRS algorithm is linear. The reason for the initial linear growth is that the number of devices is far less than the system capacity, resulting in the linear growth of the wireless resources actually allocated to devices. When the sum of DS and non-DS devices requesting services approaches the system capacity, the growth rate slows down due to the competition of wireless resources between devices. Finally, both QARA and RURS algorithms converge because the wireless resources of the system are limited. When the number of devices requesting services is far greater than the system capacity, the proportion of resources successfully used reaches a constant value. By comparing the curves of RURS algorithm and QARA algorithm, it can be seen that the system resource utilization rate of QARA algorithm is always higher than that of RURS algorithm. When both converge, QARA algorithm improves the wireless resource utilization rate by nearly 80% compared with RURS algorithm. The reasons why the performance of QARA algorithm is better than RURS are as follows: (1) the size of Ru is limited, so that the resources allocated to design economy cannot be fully utilized in RURS; and (2) the time slot resources allocated to the equipment in the RURS algorithm cannot meet the communication requirements of the equipment and waste resources [20].

The simulation results show that QARA algorithm, a dynamic resource allocation algorithm based on user QoS, breaks the performance constraints of large-scale scenarios in NB-IoT networks. From the simulation results, it can be seen that QARA algorithm has greatly improved the performance index of the number of successful service devices of the system. The simulation results shown in Figures 3 and 4 show that QARA algorithm has stronger applicability and can improve or maintain the original performance in scenarios with higher and lower QoS requirements. Through the above description, we can prove that the narrowband Internet of things resource allocation algorithm proposed in this chapter is scientific and effective.

4. Overall System Design

4.1. System Function Design. Land resource management information system mainly includes the management of basic land data, database management, announcement release management, system management, and other main functions.

(1) Land data management

The contents involved in land data management are relatively comprehensive, mainly including the management of various data of mining area, road, well pad, and station site.

(2) Database management

The database management includes database backup and recovery functions.

(3) Information release management

The information release management includes the release, modification and deletion of notices, announcements and other contents

(4) System management

Users verify their identity when logging in to determine their operation permissions. Only users with permissions can enter the management system for relevant operations. Different users have different permissions, etc. [21].

The functions of the system are shown in Figure 5.

The land resource management information system adopts the typical system architecture mode of ASP.NET Web application: database-data access layer-business logic layer-page presentation layer, as shown in Figure 6.

Table 1: Scheme of one book four.

Field name	Chinese name	Data type	Can it be blank	Remarks
Specification No.	Instruction serial number	nvarhcar	No	Primary key
AssociatedNo.	Item serial number association	nvarhcar	No	Foreign key
ResponsiblePerson	Principal	nvarhcar	No	Foreign key
Applicant Name	Name of applicant	nvarhcar	No	
Project Name	Entry name	nvarhcar	No	
ProjectC/BName	Project county/city/batch name	nvarhcar	No	
AppITotalArea	Total area of applied land	nvarhcar	Yes	
NewLand area	New land area	nvarhcar	Yes	
TotalS ituation	Total current situation_total	nvarhcar	Yes	
TotalCurrent SitO	Total current situation_state owned land	nvarhcar	Yes	
TotalCurrent SitC	Total current situation_collective land	nvarhcar	Yes	
TotalAgriculturalLand	Agricultural land_total	nvarhcar	Yes	
OwnedAgricuLand	Agricultural land_state-owned	nvarhcar	Yes	
CollecAgricuLand	Agricultural land_collective	nvarhcar	Yes	
Total arable land	Cultivated land_total	nvarhcar	Yes	
State-owned farmland	Cultivated land_state-owned	nvarhcar	Yes	
CollectiveFarmland	Cultivated land_collective	nvarhcar	Yes	
TotalBasicFarmland	Basic farmland_total	nvarhcar	Yes	
State-ownedFarmland	Basic farmland_state-owned	nvarhcar	Yes	
BasicFarmland _ collective	Basic farmland_collective	nvarhcar	Yes	
TotalWoodland	Woodland_total	nvarhcar	Yes	
State-ownedForest	Woodland_state-owned	nvarhcar	Yes	
Woodland _ collective	Woodland_collective	nvarhcar	Yes	
Total1	Total 1	nvarhcar	Yes	
Total2	Total 2	nvarhcar	Yes	
Total3	Total 3	nvarhcar	Yes	
Owned1	State-owned 1	nvarhcar	Yes	
Owned2	State-owned 2	nvarhcar	Yes	
Owned3	State-owned 3	nvarhcar	Yes	
Group1	Collective 1	nvarhcar	Yes	
Group2	Collective 2	nvarhcar	Yes	
Group3	Collective 3	nvarhcar	Yes	
ConnAssoBounSur	Association survey boundary connection	nvarhcar	Yes	
AssodAddiLand	Cultivated land connection	nvarhcar	Yes	
AssesAgen	Evaluation authority	nvarhcar	Yes	
EvaluReportNo	Appraisal report no	nvarhcar	Yes	
ProjectAppTime	Project approval time	nvarhcar	Yes	
DesignAppTime	Design approval time	nvarhcar	Yes	
ConstruFunds	Composition of construction funds	nvarhcar	Yes	
ProjectConsPeriod	Project construction period	nvarhcar	Yes	
AddLandWay	Supplementary cultivated land mode	nvarhcar	Yes	Foreign key
Remarks	Remarks	nvarhcar	Yes	

4.2. Module Design. The process of data flow and storage in the process of land resource management can be vividly represented by business flow chart and table distribution chart. Data flow diagram (DFD) is a tool to describe the system data flow. It can get rid of the physical content and describe the context and actual flow of information in a graphical way [22]. It is the most important tool to describe the logical model of management information system. The operation flow chart of some modules of the system is shown in Figure 7 below.

4.3. System Logic Architecture. There are many users accessing the system. In order to ensure the stable operation of the system, the system sets up a load balancing module. In

Table 2: District land supply information.

Field name	Chinese name	Data type	Can it be blank	Remarks
PartitionNo	Partition serial number	nvarhcar	No	Primary key
ReportingInstructionsNo	Serial number of submission instruction	nvarhcar	No	Foreign key
ProvideWays	Mode of provision	nvarhcar	No	Foreign key
FunctionPartitionName	Function partition name	nvarhcar	No	
ForArea	Land supply area	Float	No	
SettingUses	Set purpose	nvarhcar	No	
AssessPrice	Evaluation price	Float	Yes	
PriceProposed	Proposed unit price	Float	Yes	
LandLife	Land use years	Float	Yes	Unit (month)

Table 3: Agricultural land conversion scheme.

Field name	Chinese name	Data type	Can it be blank	Remarks
ReportingInstructionsNo	Serial number of submission instruction	nvarhcar	No	Primary key
TotalA griculturalLand	Agricultural land_total	nvarhcar	No	
OwnedLandArea	State owned land area	Float	No	
CollectiveLand Area	Collective land area	Float	No	
TotalArable	Cultivated land_total	Float	No	
OwnedArable	Area of state-owned cultivated land	Float	No	
FarmlandArea	Collective cultivated land area	Float	Yes	
NationalPlanning	In line with national planning	nvarhcar	Yes	
ProvincialPlanning	In line with provincial planning	nvarhcar	Yes	
CityPlanning	In line with municipal planning	nvarhcar	No	
CountyPlanning	In line with county-level planning	nvarhcar	No	
TownshipPlanning	In line with township planning	nvarhcar	No	
AdjustNationalPlanning	Adjust national planning	nvarhcar	No	
AdjustProvincialPlanning	Adjust provincial planning	nvarhcar	Yes	
AdjustCityPlanning	Adjust municipal planning	nvarhcar	Yes	
AdjustCountyPlanning	Adjust county-level planning	nvarhcar	Yes	
AdjustTown shipPlanning	Adjust township level planning	nvarhcar	Yes	
PlanTargets	Planned indicators of this year	nvarhcar	Yes	
CarryoverPlanTargets	Carry forward plan indicators	nvarhcar	Yes	
UseAgriculturalLandTargets	Proposed agricultural land index	nvarhcar	Yes	
UseFarmlandIndex	Proposed cultivated land index	nvarhcar	Yes	
PlanTargetsDescription	Indicator description of carry forward plan	nvarhcar	Yes	

Table 4: Development system and some related tools.

Name	Edition
Operating system	Windows Server 2008
Database	Oracle 9i
Application server	Tomcat7.0
Development system	Eclipse4.4
Android development documentation and debugging tools	Android SDK Software Development Kit
Struts development kit	Version 3.0
Plug-in unit	Android Development Tools (ADT)

Table 5: System operation software environment.

Server side	Windows 2008 or IIS7.0 operating system
Client	Android system

order to ensure the security of the system, the access rights open to each type of users are different. The system sets up an access control module to control the access rights based on user roles to ensure the security of the system. The functional modules of the system mainly include cadastral management, field patrol, GPS positioning, information viewing, and map switching. Each module collaborates independently and realizes information interaction through universal standard and extensible interface. In the application management system based on smart phones, the socket communication module is essential, and the corresponding function module is SMS sending module. Land information is managed by relational database. Among them, the system logic architecture design is shown in Figure 8.

4.4. Database Design

(1) Design principles

The design requirements of the database are very high, and the design is carried out in accordance with the specifications. The specific requirements of the system are as follows:

(1) Normative requirements: the data table must be named according to the standard of "T_ English Table name," so that when developers call each other, they can know what function the table is designed to achieve by looking at the database name. For the naming of fields, they must be named in capital letters, and easy-to-understand English should be used for naming as much as possible [23]

(2) Modification principle: the management of land resources is affected by many factors. Once these factors change, the database of the system may change, such as adding a field, deleting a field, and modifying a field type. These operations must be completed by the database administrator, and others have no authority to modify the able structure

(3) Paradigm control principle: in order to pursue perfection, some systems need the database to reach the third paradigm. In this system, due to more access to the database, especially the query business, the requirements for database specification are not so strict. When necessary, effective redundant fields can be set to realize the query of a large amount of data, so as to avoid the use of connection symbols in the retrieval process and improve the access efficiency

(2) Entity relationship design

According to the system data analysis and business research, the entities involved in the system mainly include parcel information, land registration application form, land registration receipt form, and parcel boundary information. A parcel is associated with multiple neighborhood information, so the relationship between them is $1:n$; A parcel of land information is associated with a land registration application form, so the relationship between the two is $1:1$. A parcel information is associated with a parcel boundary information, so the relationship between the two is $1:1$. A parcel of land information is associated with a land registration receipt table, so the relationship between the two is $1:1$. As shown in Figure 9, various business entities that will be used in the system are sorted out, and finally, the E-R diagram is formed.

(3) Design data sheet

First is one book and four schemes.

One book and four schemes are mainly used to record the information of the construction land application submitted by the construction unit to relevant units, including the name of the application unit, project name, total area of applied land, area of newly added land, agricultural area, and cultivated land area; among them, the logical structure design of the information table of one book and four schemes is shown in Table 1.

Second is district land supply information.

The regional land supply information table is mainly used to record the land information approved by each construction land application unit. The main fields include regional serial number, serial number of submission specification, mode of supply, land supply area, set purpose, evaluation price, and land use years; among them, the logical structure design of the regional land supply information table is shown in Table 2.

Third is agricultural land conversion scheme.

In the process of land use, due to the needs of urban planning, agricultural land may be converted to construction land. The information table of agricultural land conversion scheme is used to record this conversion scheme. The fields mainly include serial number of submission specification, agricultural land area, state-owned land area, collective land area, provincial planning, and municipal planning. Among them, the logical structure design of agricultural land conversion scheme information table is shown in Table 3.

4.5. System Realization

(1) Implementation environment

Due to the compatibility of Java language with multiple systems and combined with practical analysis, the program development language of this subject is Java language [24]. A series of development systems and development tools involved in the whole process of system development and design are shown in Table 4.

The requirements of system operation software environment are shown in Table 5.

The hardware environment requirements required by the system are shown in Table 6.

Table 6: Hardware environment requirements.

	Configuration requirements
The server	The main frequency of CPU is 2.5 to 3.0 GHz, with more than 2 G memory, and the server has a backup hard disk. The minimum configuration requires that the main frequency is not less than 2.0 GHz and the memory is not less than 1 G
Network bandwidth	Bandwidth system with high speed, stability, and excellent network environment
Client	Android smartphone

Table 7: User login test.

Project	Function and description
Case name	User login function test case
Function description	When entering the system, the user needs to enter the user name, password, and other relevant information in the login interface. After clicking “login,” the system will judge whether this information matches the information in the database. If it passes the verification, it will log in to the system. Otherwise, it will give information prompt
Execution process	Open the system login page, enter user information in the text box, and then click the “login” button
Input	User name: 1001, password: 1, user type: inspector
Expected output	Log in to the inspector system interface of smartphone terminal software
Actual output	Log in to the inspector system interface of smartphone terminal software

Table 8: Information release function test table.

Project	Function and description
Case name	Information release function test case
Function description	After entering the system, the administrator of the land department will create a new “information release” information of land resources. After filling in the release content, the system will automatically verify and click the “release” button. If it is complete, call the save method to save it to the database. If it is incomplete, prompt the user to modify and improve it
Execution process	(1) Successfully logged in to the system (2) Select information type (3) Enter release information (4) Integrity verification, incomplete to 5, complete to 6 (5) Prompt users to modify and improve (6) Save publishing information (7) End
Input	Mandatory parts and some necessary non mandatory parts of the information to be published
Expected output	If the information is incomplete, the system will give a prompt. If the information is complete, the system will save and return the result
Actual output	After all the required inputs are entered, the information is published successfully, and the system returns the corresponding operation results; the system can also give a prompt when the required input content is incomplete.

(2) Implementation of Web services

The EJB service endpoint does not need a corresponding Home interface, and SOAP does not implement reference transfer, so it is impossible to transfer a reference from a Web service interface or Home interface to a remote interface. In addition, it is also impossible to create and delete a Web service, so the Home interface does not need to be defined.

(3) Service description

If JAX-RPC belongs to the specification of the agreed Web service client, WSDL is the corresponding specification of the agreed Web service server and makes relevant detailed conventions and descriptions for the Web service specification, in which the description mainly includes the three most basic characteristics of the Web service:

What the service does: the operations or methods provided and supported by the service.

How to access the service: the supported data format details the necessary protocols related to the operation of accessing the service.

Where the service is located: the relevant network address determined through a specific protocol, such as URL.

Next is through the login service in the public service in the training and examination management system with typical characteristics, i.e., authority authentication service, as an analysis case.

Table 9: Summary of function test results.

Test item	Result			Test item	Result		
	Success times	Number of errors	Success rate (%)		Success times	Number of errors	Success rate (%)
Hyperlink jump check	100	0	100	Data update check	99	1	99
Submission check of duplicate data	97	3	97	Input and inspection of non-conforming data	97	3	97
Specified number of input values	99	1	99	Information addition function check	100	0	100
Information modification function check	98	2	98	Information query function check	100	0	100
Data saving check	99	1	99	System user permission check	100	0	100
Information deletion check	99	1	99				

Table 10: Server software performance test.

Content	Test result			
Server software	Server software			
Number of clients	60	120	240	360
CPU usage (%)	6	6	8	7
Physical memory usage (M)	122	124	137	133
One time connection success rate of client (%)	98.3	98.5	97.2	96.7

4.6. System Test

(1) Function test

The purpose of testing is to find problems in the developed software system this morning and solve them in time, so as to avoid more investment in maintenance after delivery to users. According to the requirements of software system development, this is the last step before delivery to users. After the system test, the problems found in the system should be quickly modified and improved [25]. In the test phase, the function test of the system adopts the method of black box test, and professional testers write test cases and form standard test reports.

First is login function test.

The login function of the system is fully tested, and the designed test table is described in Table 7.

Second is information release function test.

This function is mainly aimed at the operation of the administrator of the system. The test process design of land resource information release function is described in Table 8.

The summary table of function test results includes eleven items, including hyperlink jump check, submission check of duplicate data, input of specified number of values, information modification function check, data saving check, and system information deletion check. The summary table and test conditions are described in Table 9.

(2) Performance test

The system provides an interface for users to submit land use application information or view land resource use information through the interface; because the use information of land resources is very important, especially when measuring land use, relevant data should be submitted and saved to the server in time, so it is necessary to verify and save these data. If incomplete, give a clear and simple hint. If complete, call the save interface. In the process of statistical analysis of land resources utilization, it is necessary to analyze a large number of experimental data submitted by investigators. One or two or even thousands of land resource information cannot reflect the complete utilization of land resources. Therefore, in order to improve the pertinence of the system test and the persuasion of the data, the system simulates 300 concurrent users to access the query and statistics function at the same time, and the amount of statistical data reaches 8 million. After executing the test script, the test result is within 1 s, which meets the needs of users.

It is mainly to conduct destructive test on the bearing capacity of the server, so as to determine the service capacity of the server. There are about 200 users using the system. During the test, the paper simulates 60, 120, 240, and 360 concurrent users to access the system at the same time and records the changes of various parameters of the server. The statistical results are shown in Table 10.

After analyzing the test contents and data in Table 10, it can be seen that the resource occupancy rate is relatively low, the response is relatively timely, and the system performance is good and meets the nonfunctional requirements. Through the analysis of the above test results, it can be seen that the functional design of the system meets the needs of users and can accept the concurrent operation requests of the required number of users; the server has good performance, can process the statistical analysis and summary of big data, and can improve the work efficiency and ensure the accuracy of land resource information in the process of land resource management. The paper makes a comprehensive test on the implemented system, writes test cases, executes test scripts, and generates concurrent users. The test results show that the system has complete functional design, stable performance, and long-term and stable operation and supports the operation and use of users. The server has good performance and can handle the statistical analysis and summary of big data. It can improve the work efficiency and ensure the accuracy of land resource information in the process of land resource management. On the whole, the system has passed the test.

5. Conclusion

In this study, the mobile development platform based on Android, combined with ArcGIS Server, map tile, ArcGIS Server API for Android, and mobile positioning technology, takes the current situation of land resource management as the starting point, takes the early data and map information as the data source, and develops the "land resource management system based on mobile platform" through the analysis of land resource management business. The system can be installed on smart phones or tablets with different operating systems. The updated GIS service obtains ArcGIS Server map service through 4G network, which realizes the query of land information anytime and anywhere in land management. Through the shared API, the editing and updating of geographic data attributes, GPS positioning, and field inspection are realized. The playback of the path can be realized through the intelligent terminal. It can also publish land resource information. The development of this system is not only a part of the information construction of the land department but also a challenge for the crossplatform application of mobile GIS. In the future, crossplatform mobile GIS will have more mobile application markets. The main content is to test the function and performance of the system. The proportion of software testing in the whole system R & D cycle is very large. System testing is not the last stage of the system R & D cycle but runs through the whole system R & D cycle. System testing is a key step to verify the quality and stability of the system. In the system test, 60, 120, 240, and 360 concurrent users were simulated to access the system at the same time. The corresponding system connection success rates were 98.3%, 98.5%, 97.2%, and 96.7%, respectively. The system finally passed the test and met the needs of users. The paper makes a comprehensive test on the implemented system, writes test cases, executes test scripts, and generates concurrent users. The test results show that the system has complete functional design, stable performance, and long-term and stable operation and supports the operation and use of users. The server has good performance and can handle the statistical analysis and summary of big data. It can improve the work efficiency and ensure the accuracy of land resource information in the process of land resource management. On the whole, the system has passed the test.

Data Availability

All the data supporting the results were shown in the paper and can be available from the corresponding author.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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