An Evaluation Model of the Efficiency of Agricultural Information Resources Allocation in the Big Data Environment

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Abstract. In order to improve the ability of optimal allocation of agricultural information resources, analysis of agricultural information resources allocation efficiency, optimize the allocation of agricultural information resources, has become an important issue. An evaluation method of allocation efficiency of agricultural information resources based on huge data is raised, and the software development and design of configuration efficiency evaluation model are carried out in combination with embedded LINUX system. The big data distributed storage structure model of agricultural information resources is constructed. Quantitative regression analysis and adaptive game method are used for quantitative evaluation of agricultural information resources, big data information of agricultural information resources is excavated, regional grid clustering method is used for classification and recognition of agricultural information resources, and information fusion and adaptive scheduling of agricultural information resources are carried out under the optimized information fusion model. Embedded Linux technology is used to develop the evaluation model of agricultural information resource allocation efficiency in C/S client. The system includes data processing module, agricultural information resource allocation module, program loading module, bus scheduling module and human-computer interaction module. The integrated design technology is used to realize the software design of agricultural information resource allocation efficiency evaluation model. The test results show that the designed evaluation model of agricultural information resource allocation efficiency has good reliability and strong human-computer interaction ability, which improves the quantitative evaluation and optimal allocation ability of agricultural information resources.

Keywords: Big data environment · Agricultural information resources · Allocation · Efficiency evaluation

1 Introduction

With the development of the national agriculture and the rural construction, the management and dispatching level of the agricultural information is continuously improved, the information management of the agricultural information resources is continuously promoted, the resource allocation of the agricultural information is

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becoming more and more popular, and in the development process of the agricultural information resource allocation project, in that invention, the agricultural information resource allocation efficiency evaluation and analysis are needed, a quantitative evaluation model of the agricultural information resource is established [1]. The optimization configuration of the agricultural information resource is carried out in combination with the large data information analysis of the agricultural information resource, the agricultural information resource management and the distribution capability are improved. The evaluation model of the efficiency of agricultural information resource allocation is of crucial importance in raising the use and distribution ability of agricultural information resources [2–4].

The efficiency evaluation of agricultural information resource allocation is based on the resource information and big data information processing technology of cloud computing. Big data mining method is used to explore the relevant characteristics of agricultural information resources. Combined with feature extraction and information fusion methods, the evaluation of agricultural information resource allocation efficiency is realized. The current evaluation model of agricultural information resource allocation efficiency has a long evaluation time, which leads to a slow evaluation efficiency. Therefore, this paper puts forward the evaluation method of agricultural information resource allocation efficiency based on big data, and develops and designs the software of the evaluation model under the embedded Linux system. Firstly, we need to analyze the big data of agricultural information resources, and then design the evaluation algorithm. Finally, the evaluation model of agricultural information resource allocation efficiency is established, and the simulation results are given. The calculation time of this evaluation model is short, which shortens the evaluation time of agricultural information resource allocation efficiency and improves the evaluation efficiency.

2 Big Data Analysis of Agricultural Information Resources

2.1 Big Data Distributed Storage Structure Model

In order to realize the evaluation model of agricultural information resource allocation efficiency in the cloud computing environment, the need for building big data mining and data information storage structure model of agricultural information resources, and use directed graph analysis method to evaluate the allocation efficiency of agricultural information resources [5]. It is assumed that the information storage structure of agricultural information resources is a binary directed graph structure, and the feature distribution attribute set of agricultural information resources is $X = \{x_1, x_2, \cdots, x_n\}$. The big data distributed storage structure model for evaluating the allocation efficiency of agricultural information resources is shown in Fig. 1.

Assuming that the agricultural information resource database dataset $X = \{x_1, x_2, \cdots, x_n\}$, X is the quality of agricultural information resource data mining object set X, H is the selected feature point in the agricultural information resource database, and the key feature point matching method is used for quantitative evaluation of agricultural information resources [6]. The distribution incremental structure of agricultural

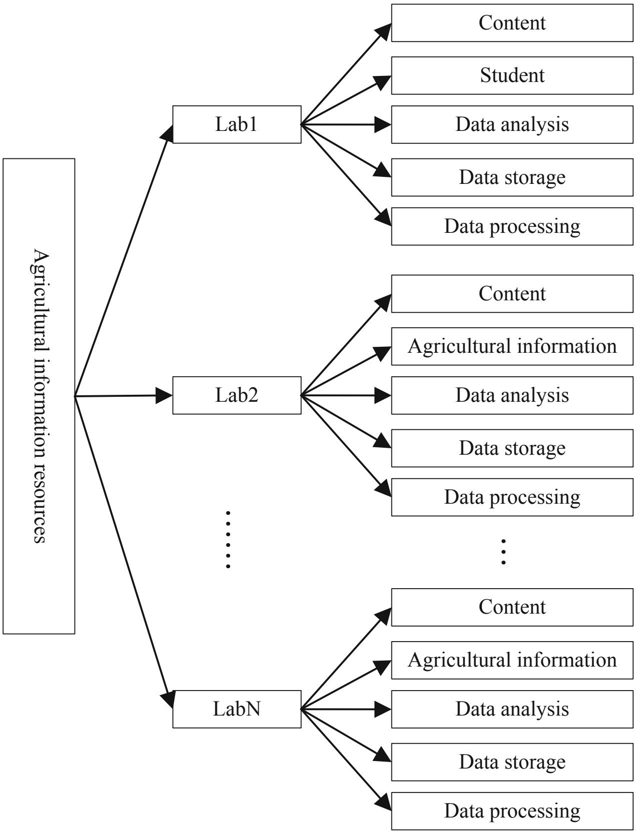

Fig. 1. Big data distributed storage structure model for evaluating the allocation efficiency of agricultural information resources

information resources is represented as an N-dimensional vector, and the information distributed migration model of agricultural information resources is obtained.

The directed graph model is used to building the quantitative evaluation node distribution structure of agricultural information resources, and the fuzzy association feature extraction and information matching are carried out in database. The linear constrained programming model for evaluating the allocation efficiency of agricultural information resources is constructed as follows:

$$\min(f) = \sum_{i=1}^{m}\sum_{j=1}^{n} H_{ij}X_{ij} \tag{1}$$

Where i is the distribution node and j is the information resource. On this basis, the optimal allocation model of Internet of things nodes is obtained to evaluate the efficiency of agricultural information resource allocation, which is recorded as $L_1, \cdots, L_n$

and $P_1^{\min}, \cdots, P_n^{\min}$. According to the distribution of storage nodes, evaluate and analyze the configuration efficiency [7].

2.2 Big Data Mining of Agricultural Information Resources

Basing on building the Big data distributed storage structure model of the agricultural information resource, the quantitative regression analysis and adaptive game method are used for quantitative evaluation and big data mining [8], and the self-adaptive scheduling parameter $\nabla^2 F(x)$ is constructed, The constraint parameters of agricultural information resource allocation efficiency evaluation are:

$$[\nabla^2 F(x)]_{kj} = \frac{\partial^2 F(x)}{\partial x_k \partial x_j} \tag{2}$$

In combination with that optimal time delay balance control method, the balance control in the evaluation process of the resource allocation efficiency of the agricultural information is carry out, a resource optimization configuration model is established, and in the cloud computing environment, the efficiency evaluation set structure of the agricultural information resource allocation is carried out [9]. The spatial planning model for obtaining the efficiency evaluation of the resource allocation efficiency of the agricultural information is expressed as follows:

$$\begin{cases} C_1(s) = \frac{\lambda_2 \min(f) + 1}{\lambda_1 + 1} \\ C_2(s) = \frac{\prod_{i=1}^{i=n} (T_{mi} \min(f) + 1)}{K_m(\lambda_2 + [\nabla^2 F(x)]_{kj})s} \end{cases} \tag{3}$$

It is assumed that the dynamic constraint parameter model of agricultural information resource allocation efficiency evaluation is described as follows: $x_j = \{x_{1j}, x_{2j}, \ldots, x_{mj}\}^T$, shares and dispatches according to the attribute distribution of agricultural information resources, and obtains the criteria of agricultural information resource information evaluation factors as follows:

$$S(i,j) = \frac{\sum_{u \in U_{ij}} (V_{u,i} - 3)(V_{u,j} - 3)}{\sqrt{\sum_{u \in U_{ij}} (V_{u,i} - \overline{V_{.i}})^2} \sqrt{\sum_{u \in U_{ij}} (V_{u,j} - \overline{V_{.j}})^2}} \tag{4}$$

Wherein, the evaluation matrix of agricultural information resources is the optimal characteristic solution of the distribution set of $R = \left(r_{\mathrm{ij}}, a_{ij}\right)_{\mathrm{m} \times n}$, agricultural information resources:

$$\Phi = diag[e^{j\phi_1}, \cdots, e^{j\phi_P}] \tag{5}$$

The mutual information entropy of agricultural information resources is introduced into high dimensional phase space, namely:

$$\begin{bmatrix} \mathbf{x}(t) \\ \mathbf{y}(t) \end{bmatrix} = \begin{bmatrix} \mathbf{A}(\boldsymbol{\theta}) \\ \mathbf{A}(\boldsymbol{\theta})\Phi \end{bmatrix} \mathbf{s} + \mathbf{n} = \overline{\mathbf{A}}(\boldsymbol{\theta})\mathbf{s} + \mathbf{n} \tag{6}$$

Taking P as the probability density of resource distribution, it is obvious that $\widehat{\mathbf{T}} = \left(\mathbf{A}^{\mathbf{H}}\mathbf{A}\right)^{-1}\mathbf{A}^{\mathbf{H}}\mathbf{U}_{\mathbf{s}} = \mathbf{A}^{+}\mathbf{U}_{\mathbf{s}}$, excavates agricultural information resources by big data according to the above analysis [10–12].

3 Evaluation of Allocation Efficiency of Agricultural Information Resources

3.1 Classification and Recognition of Agricultural Information Resources

On the basis of mining big data information of agricultural information resources, the regional grid clustering method is used to classify and identify the agricultural information resources, and the scheduling fusion model [13] is self-adaptive and resource information fusion under the optimized information, and the big data fusion technology is used to manage the information of the relevant resources, and the optimized evaluation set is obtained as follows:

$$F = \min tr\left\{\mathbf{P}_{\mathbf{A}}^{\perp}\mathbf{U}_{\mathbf{s}}\mathbf{W}\mathbf{U}_{\mathbf{s}}^{\mathbf{H}}\right\} = \max tr\left\{\mathbf{P}_{\mathbf{A}}\mathbf{U}_{\mathbf{s}}\mathbf{W}\mathbf{U}_{\mathbf{s}}^{\mathbf{H}}\right\} \tag{7}$$

The information database of the agricultural information resource is established, and a sample set distribution model of the agricultural information resource pool is obtained to meet the requirements of:

$$T_{i,j}(t) = \frac{\left|p_{i,j}(t) - \Delta p(t)\right|}{p_{i,j}(t)} \tag{8}$$

By using the fuzzy degree function of the evaluation of the efficiency of the agricultural information resource allocation represented by the $U_{i,j}(t)$. The database of resources is reconstructed by using cloud computing method, and the resources of related rule feature set that can extract relevant information are as follows:

$$TF(t, c_i) = \frac{P(t|c_i)}{\sum\limits_{j \to n} P(t_j|c_i)} \tag{9}$$

The distributed storage structure of agricultural information resources is analyzed, and the optimal solution vector of agricultural information resource scheduling is obtained as follows:

$$\mu_{ik} = 1 / \sum_{j=1}^{c} \left(d_{ik}/d_{jk}\right)^{\frac{2}{m-1}} \tag{10}$$

$$V_i = \sum_{k=1}^{m} (\mu_{ik})^m x_k / \sum_{k=1}^{n} (\mu_{ik})^m \tag{11}$$

The regional grid clustering method is used to classify and identify agricultural information resources, and the fuzzy C-means clustering method is used to construct the sub-regional grid clustering center $C(Y)$ of agricultural information resources. The distribution structure of agricultural information resources is reorganized by using similarity evaluation method to realize the autocorrelation feature matching of resources. The optimal clustering model of resources is obtained:

$$l_{d_{ij} \to c_x} = \left(\frac{\sum_{v=0}^{|c_x|} \mathrm{cosin}_{ij \to x}(d_{ij}, d_{xv})}{|c_x|} \right)^{-1} \tag{12}$$

In which, the $\mathrm{cosin}_{ij \to x}(d_{ij}, d_{xv})$ is a fusion clustering feature set of the agricultural information resource, and according to the analysis, the classification identification of the resource is realized, then the resource allocation efficiency evaluation is carried out according to the recognition result [14].

3.2 Information Fusion and Allocation Efficiency Evaluation of Agricultural Information Resources

Using decision similarity (correlation) analysis method, the fuzzy set v_i of the evaluation of agricultural information resource allocation efficiency is obtained as follows:

$$V = \{v_{ij} | i = 1, 2, \cdots, c, j = 1, 2, \cdots, s\} \tag{13}$$

Wherein, V_i is the correlation analysis measure of agricultural information resources [15], and the formula for evaluating the allocation efficiency of resources is obtained by using multiple regression analysis method:

$$U_{i,j}(t) = \exp\left[-b\left[z_i(t) - z_j(t) \right]^2 \right] \tag{14}$$

The quantitative regression analysis and the self-adaptive game method of the correlation are used, the sharing degree of the agricultural information is obtained:

$$S_{i,j}(t) = \frac{p_{i,j}(t) - sp_{i,j}(t)}{p_{i,j}(t)} \tag{15}$$

In which: $p_{i,j}(t)$ is the fuzzy correlation feature distribution set of the agricultural information resource sharing, and $\Delta p(t)$ is the fuzzy decision increment value of the agricultural information resource sharing. 4-tuple (E_i, E_j, d, t) is used to represent the main feature quantity of the agricultural information resource sharing schedule, and according to the above analysis, the correlation function of establishing the agricultural information resource information fusion and the configuration efficiency evaluation is as follows:

$$CON(t, c_i) = \log \frac{P(d|t, c_i)}{P(d|t)} = \log \frac{P(d|t, c_i)}{\sum_{i \to m} P(d|t, c_i)} \quad (16)$$

Wherein, $P(d|t, c_i)$ is the distribution probability of c_i agricultural information resource sharing scheduling. Regional grid clustering method is used to classify and identify agricultural information resources. Under the optimized fusion model, information resource fusion and adaptive scheduling are carried out [11].

4 System Software Development and Testing

on the basis of the above-mentioned algorithm design of the agricultural information resource allocation efficiency evaluation model, the software development design of the system is carried out, the embedded Linux technology is adopted to carry out the agricultural information resource allocation efficiency evaluation model software development on the C/S client side [16], the system comprises a data processing module, the resource allocation module, the program loading module, the bus scheduling module and the man-machine interaction module and the like. The device attribute table is configured to configure the DMA0_START_ADDR register, and the bus scheduling method is used for the DMAx_Y_MODIFY, DMAx_PERIPHERAL_MAP and other register configurations, and the program loading module is used for realizing the load of the evaluation algorithm of the resource allocation efficiency of the agricultural information, and the software implementation diagram of the system is shown in Fig. 2.

According to the software design described above, the software test of the agricultural information resource allocation efficiency evaluation model is carried out, the data length of the buffer data is set to 16 bits, the length of the agricultural information resource data sample is 1024, and the DMM_X_MODIFY of the test set is 2, and the large data analysis part of the agricultural information resource is obtained as shown in Fig. 3.

Big data fusion and resource allocation are carried out by using this method, and the time cost of evaluating the efficiency of agricultural information resource allocation is shown in Fig. 4.

As can be seen from the analysis in Fig. 4, the time cost of the evaluation of agricultural information resources by this method is short, and the response capability of the system is better. the stability of the test system is obtained. According to Fig. 5, the convergence of the system is better, the model designed in this paper is reliable and strong in man-machine interaction capability. And the quantitative evaluation and the optimization configuration capability of the agricultural information resource are improved.

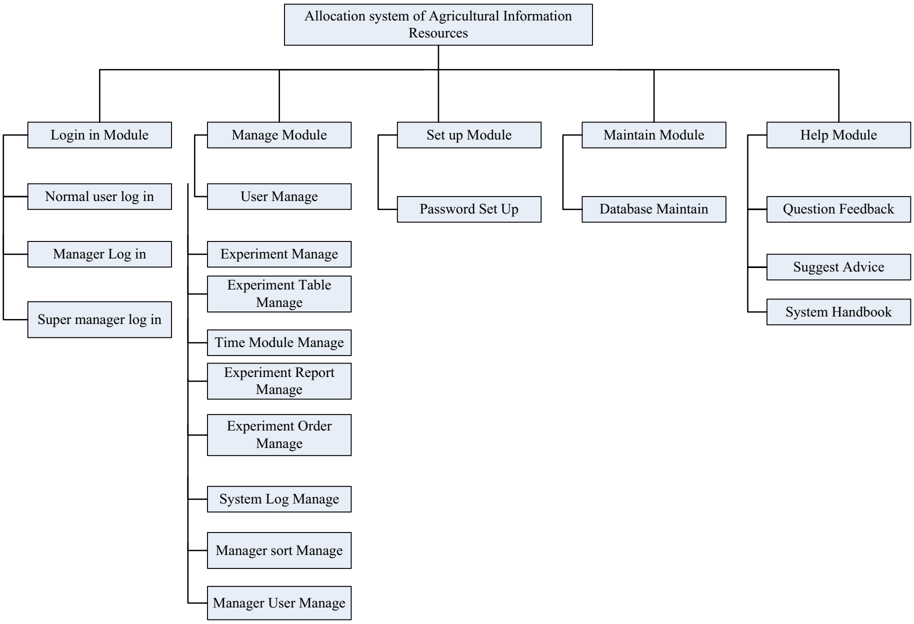

Fig. 2. Software implementation diagram of the system

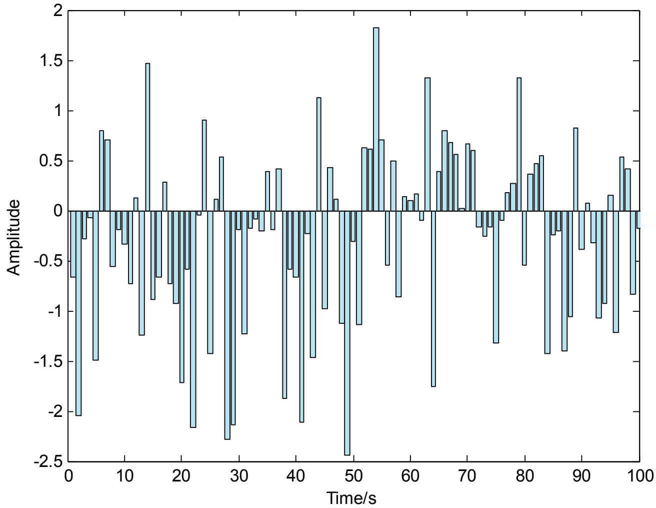

Fig. 3. Large data analysis part of the agricultural information resource

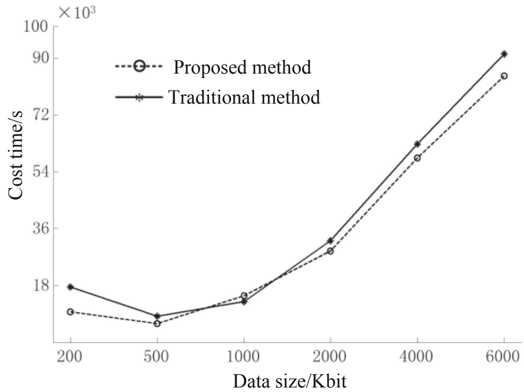

Fig. 4. Time cost of evaluating the allocation efficiency of agricultural information resources

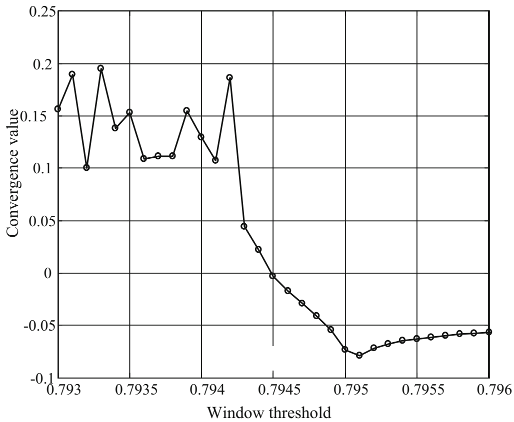

Fig. 5. Convergence test of system

Table 1. Comparison of allocation efficiency of agricultural information resources

Number of iteration steps	Proposed method	Reference [3]	Reference [4]
100	0.973	0.893	0.873
200	0.982	0.901	0.884
300	0.991	0.912	0.911
400	0.994	0.935	0.924

The efficiency of the resource allocation is tested. The results of the comparison are shown in Table 1.

It shows that the efficiency of this method is higher than that of the agricultural information resource allocation.

In order to further verify the effectiveness of the model in this paper, the calculation time of the model in this paper and the traditional model is compared and analyzed, and the comparison results are shown in Fig. 6.

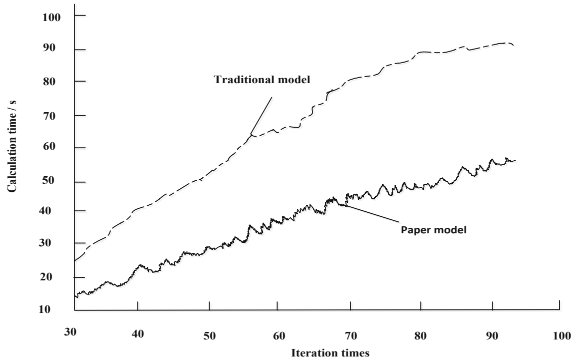

Fig. 6. Comparison results of computational time between the two models

According to Fig. 6, the calculation time of the model in this paper is shorter than that of the traditional model, which shows that the algorithm of the traditional model is more complex, while the calculation complexity of the model in this paper is lower, which shortens the calculation time, thus improving the evaluation efficiency.

5 Conclusions

In this paper, the efficiency evaluation and analysis of agricultural information resources allocation are carried out, the quantitative evaluation model of agricultural information resources is established, the ability of optimal allocation of agricultural information resources is improved, and the evaluation model of agricultural information resources allocation efficiency based on big data is put forward. The big data distributed storage structure model of resources is constructed, and the information fusion and adaptive scheduling of resources are carried out under the optimized information fusion model. The software of agricultural information resource allocation efficiency evaluation model is developed by using embedded Linux technology in C/S client. The test results show that the designed evaluation model of resource allocation efficiency has good reliability, good convergence and strong response ability.

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