



Intelligent Library Educational Information Digital Resources Retrieval Based on Ant Colony Algorithm

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Abstract. In order to improve the service quality of the smart library, the ant colony algorithm is used to optimize the design of the retrieval method of educational information digital resources of the smart library. Collect educational information digital resources of smart libraries, complete preprocessing and integration operations for different types of digital resources, and extract the characteristics of digital resources. Establish a search engine for educational information digital resources. With the support of the search engine, use ant colony algorithm to determine the optimal path of resource retrieval, and get the final retrieval results of educational information digital resources. Through the performance test experiment, it is concluded that the precision and recall of the optimized design method are increased by 7.35% and 10.55% respectively, and the retrieval response time is significantly shortened compared with the traditional method.

Keywords: Ant colony algorithm · Smart library · Educational information · Digital resource retrieval

1 Introduction

Smart library is a virtual electronic library based on computer and Internet technology. It provides readers with books, documents and other materials by means of online communication on the Internet. Smart libraries are characterized by digitalization of collection, computerization of operation, networking of transmission, liberalization of information storage, resource sharing and structural connectivity. The elements of digital library are: digital resources are the basis of materials, network access is the basis of existence, and distributed management is the advanced stage of development. The smart library is based on the idea of people-oriented public welfare and benefiting the people, so that every reader can get the same space reading and learning solutions, and enjoy the convenience and convenience brought by the smart library [1]. The establishment and development of smart libraries have brought about earth shaking changes in the study and work of readers and librarians. Therefore, the smart library based on library + Internet of Things

+ cloud computing + intelligent equipment can, on the one hand, achieve more efficient management for librarians on the basis of intelligence and autonomy, and can also provide quick and convenient information query, reading and other comprehensive services for readers. The retrieval of educational information digital resources is one of the important functions of smart libraries. Digital resources are Literature information. One form of expression of computer technology, communications technology and multimedia technology. The sum of information resources released, accessed and utilized in digital form formed by mutual integration. Resource information retrieval is a process in which people search for the required information from the World Wide Web, local area network or specific resource information database using specific search instructions, search terms and search strategies on computers or computer search network terminals, and then display or print the information by terminal devices.

At present, the retrieval methods of educational information digital resources used in smart libraries mainly include: intelligent library resource retrieval methods based on deep learning, resource retrieval methods based on Internet of Things technology, and library resource retrieval based on CGSP. However, with the support of the above resource retrieval methods, the current smart library has low hit rate of resource retrieval. Ant colony algorithm is introduced to solve the problems of incomplete resource retrieval and slow retrieval speed.

Ant colony algorithm, also known as ant algorithm, is a probabilistic algorithm used to find the optimal path in the graph. As a general stochastic optimization method, the ant colony algorithm initially only randomly selects the search path and does not need any prior knowledge. With the understanding of the solution space, the search becomes regular, and gradually approaches to the global optimal solution. Ant colony algorithm is a kind of simulated evolutionary algorithm. Preliminary research shows that the algorithm has many excellent properties. The ant colony algorithm is used to optimize the retrieval method of educational information digital resources of the smart library, so as to improve the retrieval performance of digital resources and improve the service quality of the smart library. Using a smart library as a platform, collect local resources, cooperative resources, and non cooperative resources, and segment, encode, and compress the collected resources to complete resource integration and improve retrieval efficiency. Information gain technology is used to evaluate the amount of information and extract resource features. In order to further improve the effectiveness of resource retrieval, a search engine is composed of information collector, analysis indexer, searcher and query interface to analyze the extracted information features, and Ant colony optimization algorithms is used to determine the digital resource retrieval path to achieve efficient resource retrieval.

2 Design of the Retrieval Method of Library Educational Information Digital Resources

The operation process of optimizing and designing the retrieval method of educational information digital resources of the smart library is shown in Fig. 1.

First, collect all the retrieval objects and build a centralized local text document library. Then we extract the text from the local text document library [2], extract the text

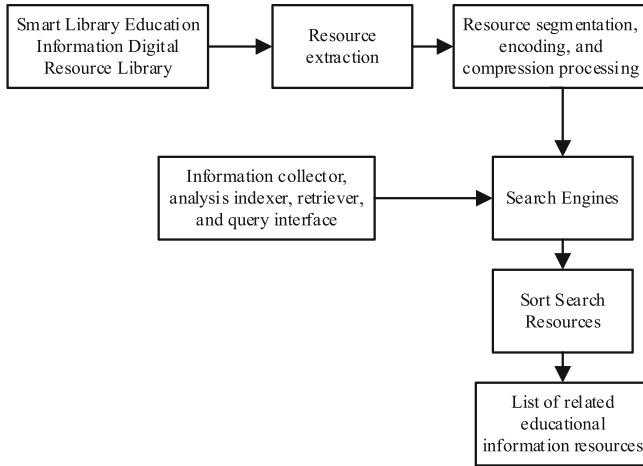


Fig. 1. Library Educational Information Digital Resources Retrieval Flow Chart

string, and preprocess the text, then we can build the index of the document. After the text document is indexed, it can be retrieved [3]. The user first submits the query to the retrieval terminal, which then directly accesses the index. After the retrieval terminal quickly obtains the collection of documents related to the query through the index, the sorting system evaluates the sorting and returns the results to the user.

2.1 Collecting Digital Educational Information Resources of Smart Library

Take the smart library as the resource collection platform, collect different types of educational information digital resources, and take this as the goal of resource retrieval. The educational information digital resources of smart libraries can be divided into three types: local resources, resources with cooperative relationships, and resources without cooperative relationships. The collection of local resources is mainly manual, and resources with cooperative relationships are mainly targeted at database suppliers. The database suppliers should build metadata that meets the specifications and standards on the premise of meeting the interoperability agreement. It should also be able to open metadata to buyers based on cooperation agreements, so as to provide retrieval functions and complete local indexing and storage operations [4]. Resources without partnership can be generated by combining manual filling and automatic generation. Finally, the collection results of educational information digital resources of the smart library are as follows:

$$E = \frac{E_{cpu} + E_{ram}}{\omega_{cpu} + \omega_{ram}} \quad (1)$$

Among E_{cpu} and E_{ram} Digital resources in CPU and memory environments, ω_{cpu} and ω_{ram} It corresponds to the weight value of CPU and memory. According to the above method, we can get the collection results of educational information digital resources of the smart library.

2.2 Integration and Processing of Educational Information Digital Resources of Smart Library

According to the resource storage format, the initially collected digital educational information resources of the smart library can be divided into text resources, image resources, audio resources, video resources and other types. Before resource integration, the digital educational information resources need to be preprocessed first. The pre-processing of text resources mainly includes Chinese word segmentation, text coding, text compression, etc. It is assumed that the collected text digital resources are B In the process of Chinese word segmentation, the string variable storing the segmentation result is recorded as C , temporary string is A , first compare the length of the Chinese string to be segmented and the size relationship of the set maximum comparison length, get the smaller value of the two, and record it as C' [5]. If the length of the string to be segmented is 0, the final segmentation result of the string will be returned directly; otherwise, the length from the head of the Chinese string to be segmented is C' Substring of A , search in the dictionary. If the string cannot be found in the dictionary C' Value minus 1, remove A For the rightmost word, use the formula 2 pairs after completing the above steps B Reassign, and the assignment result is:

$$B = B - A \tag{2}$$

The string to store the result C The assigned value is:

$$B = B + C' + \text{" /" } \tag{3}$$

Reassign the temporary storage string as an empty string, return the final segmentation result of the string, and the word segmentation of the digital text resources of the education information of the smart library is completed. In addition, the process of text encoding and compression can be expressed as follows:

$$\begin{cases} B_{\text{code}} = B \cdot \kappa_{\text{code}} \\ B_{\text{compress}} = B \cdot \kappa_{\text{compress}} \end{cases} \tag{4}$$

Variables in Formula 4 κ_{code} and κ_{compress} They are the coding and compression coefficients of text resources. The processing of image information resources includes rotation, scaling, mirroring, smoothing, enhancement, restoration, compression, reconstruction, feature extraction and recognition. Taking rotation operation as an example, the processing results are as follows:

$$\begin{cases} x' = a + (x - a) \cos \theta - (y - b) \sin \theta \\ y' = b + (y - b) \cos \theta - (x - a) \sin \theta \end{cases} \tag{5}$$

among (a, b) and (x, y) Are the position coordinates of the rotation center and the initial image resource, θ Is the rotation angle. Image scaling is to reduce or enlarge the image or part of the image area. The inspection standard for image scaling is to minimize the spatial distortion of the transformed image. When scaling, it is generally to find one or several pixels [6] in the original image corresponding to each pixel in the target image by

reverse mapping. Then, the adjacent pixel replacement method can be used to complete the addition or reduction, or the interpolation calculation method can be used to process. Similarly, the pre-processing of audio resources and video resources can be realized. On this basis, the integration result of digital resources of educational information in smart libraries is as follows:

$$E_{\text{integration}} = \sum E'_i \cdot \omega_i \quad (6)$$

Among E_i and ω_i Respectively represent the i Preprocessing results and weight values of educational information digital resources of smart libraries. Thus, the integration of digital resources of educational information in the smart library is completed.

2.3 Extracting the Characteristics of Educational Information Digital Resources

In order to facilitate the retrieval of educational information digital resources, the characteristics of integrated information digital resources are used as retrieval tags, so it is necessary to extract the characteristics of all educational information digital resources. Among them, the feature extraction objects of digital text resources are document frequency, information gain, etc. The document frequency of an entry refers to the number of documents in which the entry appears in the training corpus [7]. The adoption of feature extraction is based on the following basic assumptions: entries whose values are lower than a certain appendix value are low-frequency words, which do not contain or contain less category information. Removing such terms from the original feature space can not only reduce the dimension of the feature space, but also improve the accuracy of classification. The extraction result of document frequency characteristics is:

$$\tau_{\text{document frequency}} = \frac{m_{\tau}}{m_{\text{total}}} \quad (7)$$

In the above formula m_{τ} and m_{total} Corresponds to the number of documents with feature words and the total number of documents in the training set. Information gain is an important concept in information theory, which is widely used in text classification and information retrieval of machine learning. Information gain can be used to evaluate the amount of information reflected by word attributes in the process of sample classification. Suppose that the current educational information digital text resources can be divided into r Categories, then entries t The formula for calculating the information gain characteristics of is as follows:

$$\tau_{\text{Gain}} = -p(\bar{t}) \sum_{i=1}^{n_r} p(r_i|\bar{t}) \lg p(r_i|\bar{t}) \quad (8)$$

Variables in the above formula $p(\bar{t})$ The probability that the word t does not appear, $p(r_i|\bar{t})$ Indicates that the text belongs to the r_i Probability of class, n_r Is the number of extracted words. All terms in the training sample set should calculate their information gain value in advance, and select the attribute with the highest information gain as the feature to determine the importance of the attribute set for classification. The larger the value, the more important it is to classification and the greater its contribution. If the

information gain of lexical attributes is greater, the classification of classes will also play a greater role in the process of text information classification [8]. Therefore, in the process of feature selection, words with large information gain value are usually selected as the basis for feature selection. Similarly, we can get the feature extraction results of digital image, audio and video resources of educational information of smart library, and finally mark the comprehensive features of each educational information resource as $\tau_{con}(i)$.

2.4 Establish a Search Engine for Educational Information Digital Resources

The search engine is mainly composed of four parts, namely information collector, analysis indexer, searcher and query interface. The structure of the search engine built in the optimized design of the intelligent library's educational information digital resource retrieval method is shown in Fig. 2.

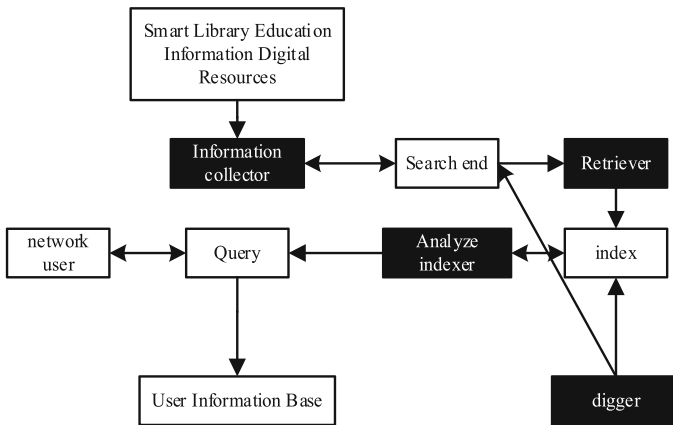


Fig. 2. Structure of educational information digital resources search engine

The operation of the information collector can be abstracted as a directed graph traversal process. When the information collector is running, as long as a small number of user configured initial smart library web pages are provided, the information collector can obtain new smart library web pages and hyperlinks according to certain algorithms, and roam in the smart library along these hyperlinks to collect information resources. The information collector visits the smart library periodically, usually once or several times a month, and the number of visits depends on the update frequency of the smart library. The performance of the information collector greatly affects the scale of the search engine site. The main function of the analysis indexer is to analyze the collected information and establish an index library for query. Analysis indexer can be divided into two parts, namely analyzer and indexer [9]. First, according to the characteristics of online data, the analyzer analyzes the collected web pages and hyperlink information according to specific algorithms, extracts the web page description information related to user retrieval, and then the indexer extracts the index items from the abstract data of

the analyzed web pages to build an index. The specific index creation process is shown in Fig. 3.

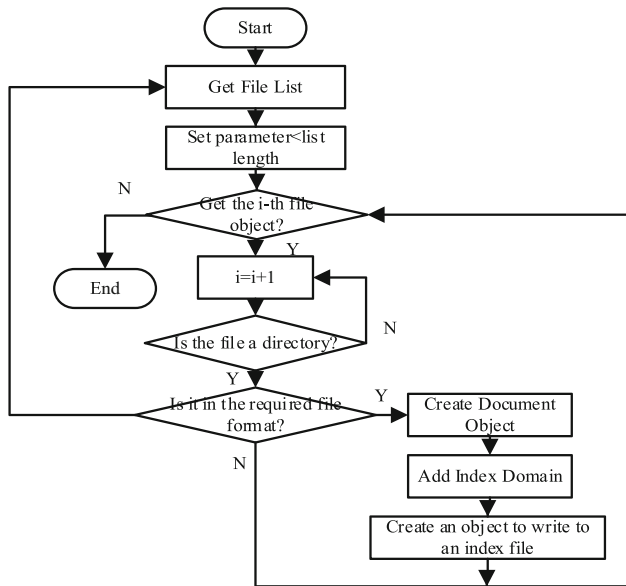


Fig. 3. Index creation flow chart

Index items are divided into objective index items and content index items. Objective index items are independent of the semantic content of the document, such as author name, URL, update time, code length, link frequency and other content index items reflect the content of the document, such as keywords and their grade values, phrases, words, etc. Content index entries include single word index entries and phrase index entries. The function of the searcher is to receive and interpret the user's search request. According to the user's query, quickly check out the document in the index library, calculate the relevance between the web page and the search request, and sort the results to be output to achieve the user relevance feedback mechanism [10]. Query interface is an interface for users to use search engines. Its main function is to input user queries, display query results, and provide user relevance feedback mechanism, so that users can use the search engine to obtain useful information efficiently and variously. Query interface technology mainly includes search request technology, search result representation technology and user behavior analysis technology. In a modular way, the composition modules of the above search engine are integrated, and the results of the establishment of the educational information digital resources search engine are obtained.

2.5 Using Ant Colony Algorithm to Determine Digital Resource Retrieval Path

In the storage space of educational information digital resources in the smart library, the retrieval path of digital resources is obtained through ant colony algorithm using the

established educational information digital resources search engine. Figure 4 shows the basic operation principle of the ant colony algorithm.

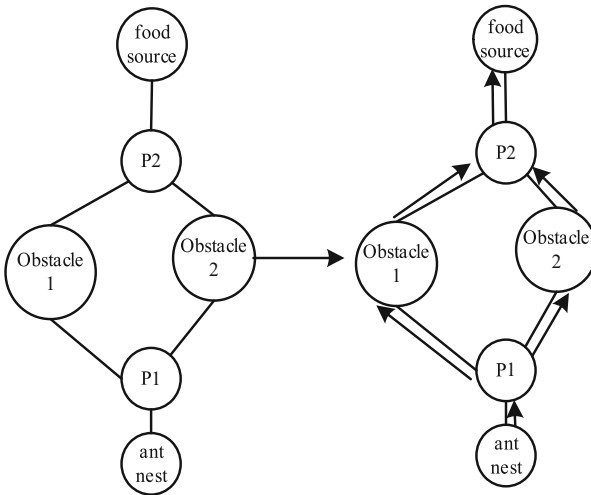


Fig. 4. Schematic diagram of ant colony algorithm

Node in Fig. 4 P_1 and P_2 Choose the way forward for Ma Nu. Ant colony algorithm mimics the process of ants searching for food through pheromones in nature. Its essence is to use the positive feedback characteristics of pheromones to make ant colony algorithm continuously self correct until it finds the optimal solution to the problem. The logic structure of the ant colony algorithm is shown in Fig. 5.

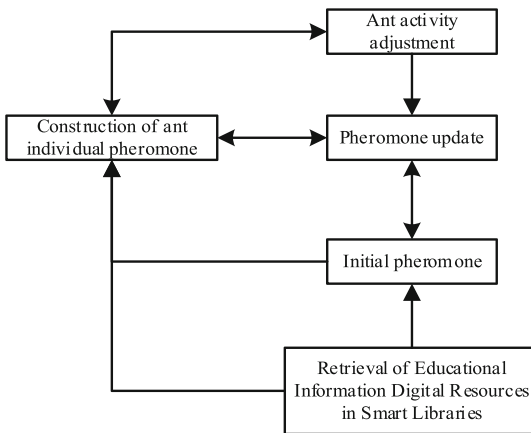


Fig. 5. Logic structure of ant colony algorithm

In the process of determining the path of digital resource retrieval, the path calculation process of ant colony algorithm can be divided into three steps: initialization, path selection, pheromone update. Nodes are set in the initialization phase i And nodes j The pheromone concentration between is 0, that is:

$$\lambda_{ij}(0) = \beta \quad (9)$$

In Formula 9 β Is a random number, that is, the path pheromone concentration between nodes at the initial time is the same, both are β . The content of path selection is to choose a path for ants, that is, to choose ants k The node to be reached in the next step. Ants k From node i Move to node j The calculation result of probability is:

$$P_{ij}^k = \begin{cases} \frac{[\lambda_{ij}(t)]^\rho [f_{ij}(t)]^\sigma}{\sum_{s \in G} [\lambda_{is}(t)]^\rho [f_{is}(t)]^\sigma} & , j \in G \\ 0 & , \text{otherwise} \end{cases} \quad (10)$$

among G It is a collection of educational information digital resources for smart libraries, $f_{ij}(t)$ For heuristic function, ρ and σ Is pheromone concentration factor and heuristic function factor, ρ It reflects the importance of accumulated information in the process of path selection, σ It reflects the importance of heuristic information in the process of selecting the path. Where heuristic function $f_{ij}(t)$ The expression of is:

$$f_{ij}(t) = \frac{1}{w_{ij}} \quad (11)$$

among w_{ij} Is the weight element in the data weight set, representing the node i And nodes j Distance between. In the path selection stage, according to the probability result calculated by Formula 10, from the collection of educational information digital resources of the smart library G Search for accessible nodes in the. Every time one is found, the node to which you want to search will be changed from G The process continues $n - 1$ Until all the educational information digital resources of the smart library have been traversed. In the pheromone update phase, when ants k When nodes in the path are discovered, pheromones will be left on the path between nodes. At the same time, with the passage of time, the pheromone left by ants on the path will also volatilize. When all ants have completed the traversal of nodes, the pheromone concentration on the path between nodes needs to be updated. Assume that the traversal completion time is $t + m$, the pheromone update result is:

$$\lambda_{ij}(t + m) = \kappa_{\text{residue}} \lambda_{ij}(t) + \Delta \lambda_{ij}(m) \quad (12)$$

among κ_{residue} Is the pheromone residual coefficient, $\Delta \lambda_{ij}(m)$ Is the change of pheromone, and the calculation formula of this variable is as follows:

$$\begin{cases} \Delta \lambda_{ij}(m) = \sum_{k=1}^m \Delta \lambda_{ij}^k(i, j) \\ \Delta \lambda_{ij}^k(i, j) = \begin{cases} \frac{Y}{L_k}, k \in l_{ij} \\ 0, \text{else} \end{cases} \end{cases} \quad (13)$$

Variables in Eq. 13 Y and L_k They are the total number of pheromones released by ants in one traversal, L_k For ants k The total length passed in one traversal, l_{ij} Is an edge ij . After the above process, the initial selection result of digital resource retrieval path can be obtained. In ant colony algorithm, only globally optimal ants are allowed to release pheromones [11]. The purpose of this selection, as well as the use of pseudo-random proportional rules, is to make the search process more instructive: ants' search mainly focuses on the field of the best path found by the current cycle. The global update is executed after all ants have completed their paths. The update result of the initially generated search path is:

$$\lambda(i, j) \leftarrow (1 - \kappa_{\text{volatilize}})\lambda(i, j) + \kappa_{\text{volatilize}} \cdot \Delta\lambda(i, j) \quad (14)$$

Among $\kappa_{\text{volatilize}}$ It is a pheromone volatilization parameter. Only pheromones on the edge of the global optimal path will be enhanced. The optimal selection result of digital resource retrieval path is obtained.

2.6 Realize the Retrieval of Educational Information Digital Resources in Smart Libraries

In the process of intelligent library education information digital resource retrieval, first judge the credibility of the search results by the ant colony algorithm. The formula for measuring the credibility of the search path is as follows:

$$\psi = \frac{U}{\sqrt{D}} * \rho \quad (15)$$

where U and D They are path and path distance. For dependability above threshold ψ_0 To calculate the similarity between digital resources and input keywords. The calculation result is:

$$\phi = \frac{\tau_{\text{con}}(i) \cdot \tau_{\text{keyword}}}{\|\tau_{\text{con}}(i)\| \cdot \|\tau_{\text{keyword}}\|} \quad (16)$$

Variables in Eq. 16 τ_{keyword} If the calculation result of formula 16 is higher than the threshold value ϕ_0 , Certification $\tau_{\text{con}}(i)$ The corresponding digital resource belongs to the resource retrieval result, otherwise it is considered that the resource does not belong to the retrieval result. Finally, the search results that meet the similarity conditions will be arranged in order from large to small, and the search results of the educational information digital resources of the smart library will be output in a visual form.

3 Experimental Analysis of Retrieval Performance Test

To test and optimize the retrieval performance of the intelligent library educational information digital resources retrieval method based on ant colony algorithm, design a performance test experiment. The basic idea of this experiment is to prepare the intelligent library educational information digital resources and retrieval keywords, and determine the number of similar resources corresponding to the retrieval keywords according to the

preparation of the resources. This is used as the comparison standard to judge the retrieval performance of resources. By calculating the gap between the output retrieval results and the expected retrieval results, the quantitative test results reflecting the retrieval performance of the optimized design method are obtained.

3.1 Building an Experimental Test Environment

This experiment selects OverSim platform as the development environment. OverSim is an open source overlay framework based on OMNeT+ +. OverSim is highly modular, and its structure can be divided into three levels, namely underlay, overlay, and application from bottom to top. Underlay layer mainly constructs the underlying basic network, overlay layer mainly contains structured and unstructured running protocols, and application layer is the running program based on the application layer. Because OverSim has a strong graphical interface and real-time display capability, it can find errors in the running process of the retrieval program in the early stage of running. In addition to the development platform of intelligent library educational information digital resource retrieval method based on ant colony algorithm, it is also necessary to select hardware equipment. The optimization design method uses Dell server as the hardware support, Acer EX214 as the main computer of the retrieval method, and SQLServer2005 as the storage environment of intelligent library educational information digital resource samples.

3.2 Prepare Samples of Educational Information Digital Resources of Smart Library

This experiment selects all text and image education information in the smart library as digital resource samples. Text information includes the basic introduction of each book, such as book name, book author, publishing house, preface, catalog, book content, etc., while image education information mainly includes book cover images and electronic books. Through data statistics, the educational text information resources prepared for this performance test experiment are 65 GB in total, and the image resources are 55 GB in total.

3.3 Generating Digital Resource Retrieval Cases

According to the preparation of educational information digital resource samples of the smart library, search cases of digital resources are generated. The results of some search cases are shown in Table 1.

In the actual retrieval process, the retrieval keywords in the generated retrieval cases are input into the retrieval program. In order to ensure the credibility of the experimental results, the experiment generated a total of 80 search cases, and clearly marked the search keywords and the expected number of searches.

Table 1. Digital resource retrieval use case table

Case number	Search keywords	Search Type	Expected retrieval quantity/GB
1	Journey to the West	Text retrieval	16.4
2	Journey to the West	image retrieval	9.8
3	The Dream of Red Mansion	Text retrieval	12.6
4	The Dream of Red Mansion	image retrieval	5.2
5	Five thousand years in China	Text retrieval	13.7
6	Five thousand years in China	image retrieval	6.8
7	the Imperial Palace	Text retrieval	11.7
8	the Imperial Palace	image retrieval	7.1

3.4 Input Operation Parameters of Ant Colony Algorithm

Because the optimization design method uses the ant colony algorithm as the support, it is necessary to set the operation parameters of related algorithms. The details are shown in Table 2.

Table 2. Running parameters of Ant colony optimization algorithms

Parameter	Value
Volatility coefficient of Pheromone	0.5
Initial value of distance heuristic factor	1
Initial value of Pheromone heuristic factor	5
Total Pheromone	200
Ant number	20
Maximum survival cycle of ants	12
Path selection probability threshold	0.5

Input the setting results of the above ant colony algorithm running parameters into the running program corresponding to the intelligent library’s educational information digital resource retrieval method.

3.5 Describe the Performance Test Experiment Process

Through the file configuration parameters, load the corresponding modules of the system to realize the steps of initial resource sample import, optimization design method coding, retrieval method switching, etc. Input the keywords in the generated search cases one by one into the running program of the intelligent library education information digital

resource retrieval method based on the ant colony algorithm, and output the corresponding search results, including the output results of the No. 1 and No. 2 search cases, as shown in Fig. 6.

**Smart Library Education Information Digital
Resource Retrieval**

Enter keywords:

Select retrieval type:

Search Results

[Journey to the West](#): The Strategic Importance of China's Western Frontiers

The monkey & the monk : a revised abridgment of The [journey to the west](#)

[The Journey to the West](#): Vol 004

A Modern Chinese [Journey to the West](#): Economic Globalization and Dualism

[Journey to the West](#) : reading communicative language teaching in Australia

Reeling in the Demon: An Exploration into the Category of the Demonized Other as Portrayed in The [Journey to the West](#)

Feeling of Entering the World ——Confucian Thought in a [Journey to the West](#)

(a) Text Resource Search Results

**Smart Library Education Information Digital Resource
Retrieval**

Enter keywords:

Select retrieval type:

Search Results

Image 1



Image 2



Image 3



Image 4


Image 5


Image 6


(b) Image resource retrieval results

Fig. 6. Retrieval Results of Library Educational Information Digital Resources

The output results of all search cases can be obtained according to the above method. In order to reflect the advantages of the optimization design method in the resource retrieval performance, the traditional intelligent library resource retrieval method based on deep learning and the resource retrieval method based on the Internet of Things technology are set as the experimental comparison method, and the above process is repeated to realize the development and operation of the comparison method, and output the resource retrieval results of the comparison method.

3.6 Setting Experimental Indexes for Retrieval Performance Test

The precision ratio and recall ratio of the educational information digital resources of the smart library are set as the quantitative test indicators to verify the retrieval performance. The precision ratio is the percentage of the number of relevant documents detected and the total number of documents detected. Recall ratio refers to the amount of relevant documents detected and the total amount of relevant documents in the retrieval system percentage. The numerical results of the above indicators are as follows:

$$\begin{cases} \eta_{\text{accurate}} = \frac{N_{\text{correct}}}{N_{\text{out}}} \times 100\% \\ \eta_{\text{all}} = \frac{N_{\text{correct}}}{N_{\text{all}}} \times 100\% \end{cases} \quad (17)$$

Variables in Eq. 17 N_{correct} , N_{out} and N_{all} They respectively represent the amount of resource data retrieved correctly, the amount of resource data successfully output by the retrieval method, and the total amount of resource data prepared for the experiment. By comparing the output results of the retrieval method with the expected results, we can get N_{correct} The specific value of. In addition, in order to verify the operation performance of the retrieval method of educational information digital resources of the smart library, the response time is set as a quantitative test indicator, and the test results of this indicator can be expressed as:

$$T = t_{\text{out}} - t_{\text{retrieval}} \quad (18)$$

among $t_{\text{retrieval}}$ and t_{out} It should be the start time of the retrieval program and the output time of the retrieval results. Finally calculate the precision η_{accurate} And recall η_{all} The larger the value is, the better the retrieval performance of the corresponding method is, and the response time is T The smaller the size, the better the performance of the corresponding retrieval method.

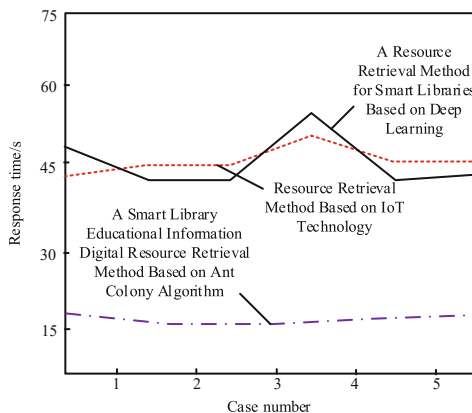
3.7 Retrieval Performance Test Results

Through the statistics of relevant data, the test results reflecting the retrieval performance are obtained, as shown in Table 3.

By substituting the data in Table 3 into Formula 17, it is calculated that the average precision and recall of the two comparison methods are 89.5% and 92.6%, 84.7% and 89.0%, respectively, while the average precision and recall of the optimized design method are 98.4% and 97.4%, respectively. In addition, the response time test results of

Table 3. Results of Information Digital Resource Retrieval Performance Test

Case number	Intelligent Library Resource Retrieval Method Based on Deep Learning		Resource retrieval method based on Internet of Things technology		Retrieval Method of Educational Information Digital Resources in Smart Library Based on Ant Colony Algorithm	
	Retrieve the correct amount of resource data/GB	Amount of resource data successfully output by retrieval method/GB	Retrieve the correct amount of resource data/GB	Amount of resource data successfully output by retrieval method/GB	Retrieve the correct amount of resource data/GB	Amount of resource data successfully output by retrieval method/GB
1	15.1	15.8	15.5	16.0	16.2	16.3
2	8.7	9.3	9.0	9.5	9.6	9.8
3	11.1	11.7	11.2	12.1	12.5	12.6
4	4.1	5.0	4.4	5.0	5.0	5.1
5	12.7	13.3	13.1	13.4	13.4	13.6
6	5.2	6.2	5.4	6.3	6.4	6.7
7	10.4	11.1	10.5	11.2	11.3	11.5
8	5.1	6.6	6.2	6.8	7.0	7.0

**Fig. 7.** Response Time Test Comparison Results of Resource Retrieval Methods

three retrieval methods are obtained through the calculation of Formula 18, as shown in Fig. 7.

From Fig. 7, it can be intuitively seen that the response time of the three algorithms is different. Among them, the response time of the comparison method is around 45 s,

while the response time of the optimization design method is shorter and always below 20 s, indicating that the optimization design method has obvious advantages in terms of operational performance.

4 Conclusion

Smart library is an intelligent building formed by applying intelligent technology to library construction. Intelligent building with highly automated management Digital Library Organic combination and innovation. Smart library is a concept that is not limited by space, but can be actually perceived at the same time. Someone once said that the smart library will realize intelligent service and management through the Internet of Things. In fact, it also includes some cloud computing and intelligent equipment, through which to transform the traditional library. In order to improve the service quality of the smart library, this paper puts forward a retrieval method of educational information digital resources of the smart library based on ant colony algorithm, and applies it to the actual library environment. Collect educational information digital resources using a smart library as a platform, integrate the collected resources, extract resource features using information augmentation technology, establish a search engine to analyze the extracted information features, and use ant colony algorithm to achieve efficient resource retrieval. From the experimental results, we can see that compared with traditional methods, the retrieval quality and retrieval speed of the optimized design method have been significantly improved, which is of positive significance for the operation of smart libraries.

With the continuous updating of educational resources, the retrieval of educational information digital resources in smart libraries may involve multiple objectives or constraints. In future research, Ant colony optimization algorithms can be extended to multi-objective optimization and multi constraint problems to achieve more flexible and comprehensive resource retrieval and provide appropriate resources for teachers and students.

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