Intelligent Recommendation Model of Distance Education Courses Based on Facial Expression Recognition

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Abstract. Aiming at the lack of individualization of current course resources in distance education, an intelligent recommendation model for distance education courses based on facial expression recognition is designed. Extract data that can represent the characteristics of the resource, such as title, subject, category, path, source, author, date, keywords, description information, etc., and represent the resource in the form of learning object metadata under the LOM specification. Use Reload Edtior 2.5.5 to edit metadata and package course content. Through the establishment of learning resource model, the structure of resources is more obvious, which is convenient for resource sharing and searching. Using the modeling method of requirement tree, the user requirement model is constructed based on ontology. Based on facial expression recognition, the framework of Intelligent Recommendation Model of distance education course is built, and the intelligent recommendation model of distance education course is constructed. Through comparative experiments, it is verified that the recommendation accuracy of Intelligent Recommendation Model Based on facial expression recognition is higher than the other two recommendation models, and it has high practicability.

Keywords: Facial expression recognition · Distance education · Curriculum intelligent recommendation model · Metadata

1 Introduction

With the advancement of information technology, the popularity of 4G/5G network, wireless network and smart phone, people's quality of life and work have undergone tremendous changes. Through the network, people can use the distance education platform to learn, download network resources and related learning courseware, so that it is no longer limited to time or space, but also can carry out supplementary learning of relevant knowledge, effectively improving the learning efficiency of students [1]. Students can understand, learn, interact, upload assignments and download teaching materials through the online education platform; teachers can upload learning materials and videos and answer questions online.Since 1998, my country has developed distance

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education. Up to now, it has experienced several stages including correspondence education, electronic distance, multimedia and interactive network teaching methods. With the continuous promotion of information technology, users in recent years The scale has grown rapidly [2]. According to the "Statistical Report on China's Internet Development Status" released by CNNIC, by December 2018, the number of online education users in my country had reached 201 million, an increase of 46.05 million from the previous year; and the number of online education users The utilization rate reached 24.3%, an increase of 4.2% compared to the previous year. At the same time, the number of online education users using mobile phones reached 194 million, an increase of 75.26 million compared to the previous year; and the utilization rate of mobile phone online education users reached 23.8%, an increase of 8% compared to the previous year.However, due to the online education platform only displays the offline related course content and resources, to a certain extent, due to the space and time constraints of distance education, the interaction between teachers and students is poor, and the learning efficiency is not high; at the same time, all students are taught in the same mode, which fails to reflect the personalization and is difficult to achieve To the purpose of online education to improve learning efficiency. Therefore, this paper studies the intelligent recommendation model of distance education courses, and proposes an intelligent recommendation model of distance education courses based on facial expression recognition. Firstly, metadata processing is carried out for distance education curriculum resources. Then, according to the processing results, metadata is edited and curriculum resources are packaged. According to different learning object levels, learning resource model is established to obtain user needs. Based on the needs, intelligent recommendation model for distance education curriculum is constructed, Complete the intelligent recommendation model of distance education course based on facial expression recognition.

2 Design an Intelligent Recommendation Model for Distance Education Courses Based on Facial Expression Recognition

2.1 Metadata of Curriculum Resources

Metadata refers to information used to describe elements, data sets, etc. Simply put, it is the data describing the data. Due to too many types of educational resources in the network, these resources must be collected after basic processing [3]. First, extract the data that can represent the characteristics of the resource, such as title, subject, category, path, source, author, date, keywords, description information, etc., and at the same time represent the resource in the form of learning object metadata under the LOM specification. After the collection of basic data elements based on LOM standard, it is necessary to design a metadata model according to the design requirements of the actual resources and the actual situation, complete the XML document under the syntax requirements of XML schema, and then further create the user's own metadata instance [4]. Table 1 below is a reference table of metadata information in some LOM standards, and Table 2 is a table of educational resource information that represents the basic characteristics of resources in the process of collecting educational resources.

Table 1. Metadata information table

Numbering	LOM metadata	Explanation
1	General	Some general information about the learning object
1.1	General. Title	The name of the learning object
1.2	General. Keyword	Keywords describing the subject of the learning object
1.3	General.Catalogentry	The label of the learning object (unique)
1.4	General. Language	The main language used by the learning object
1.5	General. Description	Description of the content of the learning object
2	Lifecycle	The state of the learning object and the entities that act on it
2.1	Lifecycle. Contribute	Entities that contribute to the development of learning objects
3	Metametadata	Metadata itself
3.1	Metametadata.Contribute	Entities that contribute to the development of metadata
3.2	Metametadata.Language	The language used to describe metadata
4	Technical	Technical requirements and related characteristics of learning objects
4.1	Technical. Format	Data type of learning object
4.2	Technical. Size	The size of digital learning objects
4.3	Technical. Location	String used to indicate how to obtain the learning object

Table 2. Educational resource information table

Serial number	Resources	Message name
1	Title	Title
2	Theme	Subject
3	Category	Class
4	Path	Path
5	Source	Source
6	Author	Author
7	Date	Date
8	Keyword	Keyword
9	Description	Description

2.2 Metadata Editing and Course Resource Packaging

It uses reload editor2.5.5 to edit metadata and package course content. It is a software that integrates different digital teaching media to conform to SCORM format [5]. Among the standards followed by reload editor, the content package supports IMS 1.1 and SCORM 1.2 standards.

The main function of Reload Editor 2.5.5 is to edit the attributes in the metadata, while creating, inserting, editing and exporting course packages containing metadata for our use.

Before using this software, you need to install javasetup 6u30, and then click reload-editor.jar You can enter the interface. The specific operation methods of metadata editing and course resource packaging are as follows: first, store the learning resources of the course in a folder (note that the name of the folder where the learning resources are stored cannot be Chinese), and the hierarchical structure of the resources in the file should be clear.In the course content packaging, first import the target course resources into the resources (Resources) panel of the software; secondly, add the organizational structure of the course in the structure function (under Organizations) in the display (Manifest) panel, and add the course resources to the course project ((Items), finally add metadata or import metadata files, and package them [6].

In the use of the software, special attention should be paid to:

1. Chinese Directory needs to pay attention to the deletion of spaces.
2. The course structure should meet the needs of packaging design.
3. There are two ways to create a directory. One is to drag, the other is to right-click and drag again.
4. The name of the hard disk where reload endtior is stored cannot be Chinese.
5. The name of the folder where learning resources are stored cannot be Chinese.

2.3 Establishment of Learning Resource Model

After metadata processing, educational resources will be divided according to different levels of learning objects, and the description of metadata will be obtained and stored in the education resource database, as shown in Fig. 1 [7]. There will be one to many, many to one and one to one relationships between educational resources and learning objects at different levels. According to the different learning needs and the design requirements of educational resources, the detailed division of learning objects is determined. Therefore, after metadata, we must establish the learning resource model to make the structure of resources more obvious, which is convenient for sharing and searching resources, and has an immeasurable effect on the optimization of online courses.

In the constructed learning resource model, the learning resources are described based on the LOM specification. By importing the LOM metadata, the metadata in the LOM standard is corresponding to the corresponding keywords, and then the important keywords are extracted as modeling the conditions [8]. The expressions extracted from key words are:

$$\alpha_n = \sum_{i=1}^{n} s_n w \tag{1}$$

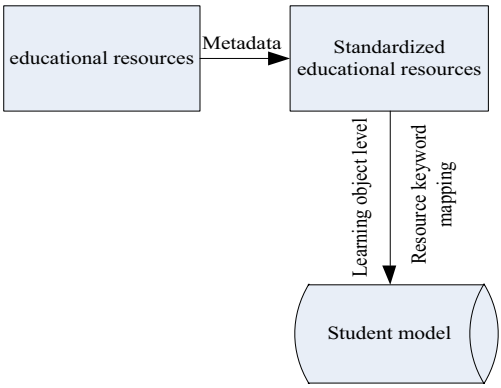

Fig. 1. Construction of educational resource model

The mapping relationship between descriptions and keywords is shown in Table 3.

Table 3. Keyword mapping table

Numbering	Key words	LOM metadata	For example
1	Author	LifeCycle.Contribute.role	Fang Min, Wang Yaping
2	Keyword	General. Keyword	Operating system, computer
3	Language	General. Language	Zh
4	Media format	Technical. Format	PPT/TXT
5	Resource ID	General.Entry	132
6	Resource path	Technical. Location	E:\Computer OS\…
7	Educational situation	Educational.Context	Higher education
8	User role	Educational.IntendedEndUserRole	Learner/resource builder
9	Subject classification	Classification. taxon	Computer
10	date	LifeCycle.Contribute.data	year 2011
11	Class hours	Education. Typical Learning Time	50 h
12	relationship	Relation.kind.Value	ISPartOf

2.4 Building User Demand Model

Using the modeling method of demand tree, build user demand model based on ontology. Mainly by using the conceptual relationship in the domain ontology theory to conceptualize the user demand model, and to select the same-level relationship and the relationship between the upper and lower levels in the model, which can form a tree-like "demand tree" Structure of user demand model.

There are two main functional modules in the user demand model: establishment and modification. Among them, there are two ways to establish the module: explicit and implicit. Explicit is to collect students' information, that is, students select the required knowledge points by manual operation. Students can manually select the knowledge point concepts they need and enter their information into the corresponding demand tree. Therefore, when a student logs in to the model, the model will automatically check whether the manual operation demand tree has been set up completely. If not, a new demand tree with missing content needs to be created for the student immediately; if so, it will Return directly to the demand tree that it has established.The other is to collect data in a recessive way, that is, to excavate students' behavior deeply and find out the corresponding information. In the case of no impact on the behavior of students, through this way, the model will automatically conduct in-depth mining of their behavior, find out which knowledge points the student needs, and fill it into the student demand tree [9].

The modification function module in the user demand model is mainly composed of two components: demand update and automatic recommendation. The update function required by students also includes manual and automatic methods. The reason for manual update is that there will inevitably be differences between the model recommendation and the students' rational choices. Therefore, in order to reduce this deviation, it is necessary to manually modify the student's demand tree, which includes the concept of adding and deleting knowledge points, and The evaluation weight of knowledge point needs is modified and deleted, or short-term learning needs are added. The automatic update means that the model automatically updates the content by accessing the information recently browsed by the students and filtering. The recommendation function in the model is to recommend through the knowledge points in the student demand tree. If the recommended information can be adopted by the students, it indicates that the recommendation provided by the model is more effective.If it is not adopted by students, it shows that the result recommended by the model is not the best. At this time, it is necessary to modify the demand tree to meet the needs of students for knowledge points of the course.

The constructed user demand model is shown in Fig. 2.

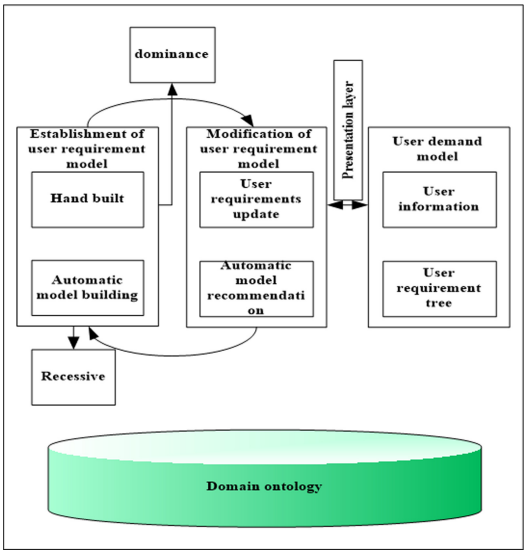

Fig. 2. Constructed user demand model

2.5 Constructing an Intelligent Recommendation Model of Distance Education Courses

Based on facial expression recognition, the framework of Intelligent Recommendation Model for distance education courses is constructed. Among them, the backstage management unit of the framework is developed by using spring boot server framework and mybatis persistence layer framework. The front end uses HTML5 and JavaScript language, adopts a set of general background management template system charisma, which is based on facial expression recognition technology. It is convenient, simple and has good compatibility, and uses postman to do interface test. In the aspect of database, MySQL is chosen as the data-driven source. The interface test recommendation engine algorithm module is written in Python and deployed independently, which can realize offline calculation [10–12]. After the recommendation results calculated by the recommendation engine are stored in the database, the recommendation model can be processed again according to the configuration information, and finally provide calling services for the master station in the form of an interface.

The intelligent recommendation model of distance education course can be divided into user interest recommendation module, similar course recommendation module and background management service module.

Among them, the main function of the user interest recommendation module is to provide courses recommendation interface services in line with their interests for the students in the main station such as the cadre network education and training platform. The recommended list of each student in the model has been calculated by the recommendation engine, so this interface only needs to query the corresponding data from the corresponding data table through the passed student ID when it is called and return it to the student. When the main station student logs in to the personal center, the browser

triggers a JS script to send an Ajax request to the user interest recommendation service to obtain personalized recommendation results.

The specific processing flow of the system after receiving the Ajax request is as follows:

Step 1: after receiving the Ajax request, go to the listbyuser method in the recommendcontroller according to the request address.

Step 2: judge whether the student ID in the request parameter is empty in the listbyuser method. If it is empty, an error code is returned. If not, the selectcoursebyuser method of recommendcourseservice is called to obtain the recommended candidate set.

Step 3: after obtaining the list of recommended candidates, if there are recommended courses specified by the system, such as compulsory courses, the two methods will be fused, and finally the recommendation results will be returned to the students in JSON format.

The main function of the similar course recommendation module is to recommend courses similar to the course when the students browse the detailed information of a course. If a student is looking for course resources of interest, there is a difference between the course developed and the target course, and the course needs to be searched again. In order to avoid this problem and improve the student experience, the recommendation module is designed to provide similar recommendation services for existing courses. All courses in the model have been calculated by the recommendation engine and the results have been stored in the data table. Therefore, the interface service of this module only needs to query the corresponding data from the corresponding data table through the passed course ID when it is called and return it to the students..

When the students of the main station browse the detailed interface of the course, the browser will send the Ajax request to this module to obtain the recommended list of similar courses from JS script. The specific processing flow of the model after receiving the Ajax request is as follows:

Step 1: after receiving the Ajax request, the system will go to the corresponding processing function (listbycourse method in recommendcontroller) according to the request address.

Step 2: judge whether the course ID in the request parameter is empty in the listbycourse method. If it is empty, an error code is returned. If not, the selectcoursebycourse method of recommendcourseservice is called to obtain the recommended candidate set.

Step 3: after obtaining the recommended candidate list, filter the candidate set according to the setting information, and finally return the recommendation result to the students in JSON format.

The background management service module is the management platform of the whole recommendation model, and its main functions include login, account management, designated course setting, recommendation configuration and so on.

3 Experimental Verification of Intelligent Recommendation for Distance Education Courses

3.1 Experimental Design

The experimental environment configuration is shown in Table 4.

Table 4. Experimental environment configuration

Serial number	Configuration	Data
1	Computer hardware configuration	CPU: AMD Athlon (TM) II X4 640 Main frequency:3. O1 GHz RAM:3. 25GB
2	operating system	Microsoft Windows XP
3	Metadata editing and course content packaging	Reload Editor 2.5.5
4	Low-level software	Xampp1.7.7 Java
5	testing platform	Joomla 1.7.3
6	Use templates	schoolnerdfree-1. 0. 0
7	Use plugin	Google Analytics

The experimental network topology is shown in Fig. 3.

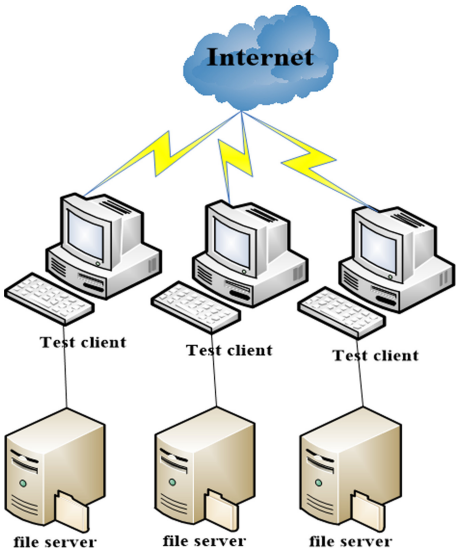

Fig. 3. Experimental network topology

Based on the experimental environment, the intelligent recommendation model of distance education courses based on facial expression recognition is carried out. The analysis data used in the experiment is mainly from Beijing 101 online school, which has opened more than 90 courses with a wide coverage, and the number of online students has reached more than 10000. The data obtained by using crawlers include all the basic information of students, behavior retrieval browsing, collection information, and the relevant information and knowledge point evaluation of each mathematical knowledge point. Therefore, through the use of the network school data for research, will make the recommendation results more accurate and more reliable.

In the experiment, 3563 pieces of student scoring data on the knowledge points of middle school mathematics were extracted to build a data set, which contains 3316 students' scores for 26 knowledge units of middle school mathematics, and each student's score for the knowledge unit must be 10. And above, the scoring value is set to all integers from 0 to 100. In addition, the higher the students' scores for knowledge points, the more they are eager for knowledge points.

Use accuracy to evaluate the intelligent recommendation model of distance education courses based on facial expression recognition. The average absolute deviation MAE can effectively measure the deviation between the predicted score value and the actual score value, calculate the deviation, and then measure the accuracy of the prediction. The smaller the value of MAE, the better the recommended results.

In order to make the experimental results more comparative, the two original intelligent recommendation models of distance education courses are taken as the comparison models, including the intelligent recommendation model of distance education courses based on collaborative filtering and time weighted algorithm. The MAE experimental data of three intelligent recommendation models of distance education courses were compared.

3.2 Analysis of Results

The MAE comparison experiment data of distance education course intelligent recommendation model based on facial expression recognition and distance education course intelligent recommendation model based on collaborative filtering and time weighted algorithm are shown in Table 5.

According to the MAE comparison experimental data in Table 5, the average absolute deviation of the distance education course intelligent recommendation model based on facial expression recognition is smaller than that of the distance education course intelligent recommendation model based on collaborative filtering and time-weighted algorithm, that is, based on facial expression recognition The recommendation accuracy of the intelligent recommendation model for distance education courses is higher than that of the other two recommendation models.

Table 5. MAE comparative experimental data

Nearest neighbor student users	Recommendation model based on facial expression recognition	Recommendation model based on collaborative filtering	Recommendation model based on time weighted algorithm
	Mae average		
50	0.720	0.792	0.852
100	0.710	0.781	0.835
150	0.704	0.774	0.816
200	0.692	0.761	0.805
250	0.685	0.756	0.793
300	0.671	0.752	0.782
350	0.665	0.741	0.771
400	0.652	0.730	0.761
450	0.641	0.721	0.758
500	0.632	0.701	0.749
550	0.620	0.700	0.732
600	0.610	0.692	0.721
650	0.605	0.682	0.710
700	0.601	0.671	0.705
750	0.592	0.668	0.692
800	0.582	0.652	0.682
850	0.571	0.647	0.671
900	0.569	0.638	0.661
950	0.554	0.624	0.654
1000	0.541	0.617	0.641

4 Concluding Remarks

The current distance education platform should pay more attention to students' development and demand preference. Therefore, an intelligent recommendation model of distance education course based on facial expression recognition is designed to obtain metadata based distance education course resources, edit and package them, divide learning resources according to different learning object levels, and construct user demand model, Realize intelligent recommendation of distance education courses.. The intelligent recommendation model of distance education course based on facial expression recognition improves the accuracy of recommendation, and can solve the problems of various course recommendation, unclear purpose and noise data in many education platforms. It can provide students with more scientific and reasonable knowledge.

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