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An intelligent integration method of AI English teaching resources information under multi-agent cooperation

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Abstract: The traditional integration method has low integration accuracy and long integration time. AI English teaching resource information intelligent integration method, a multi-agent collaborative algorithm for intelligent integration of intelligent English teaching resources is proposed. Based on observation results of user implicit feedback, a user interest model is constructed. The interest model is formulated into a vector set composed of multiple vectors. The weight of the ontology is estimated by number of re-entry, content, behaviour, object and time, and the bias strength of the user ontology for a certain field is obtained. An information intelligent integration model under the cooperation of multi-agents is constructed. Thus, AI English teaching resources can be intelligently integrated. The simulation results show that the integration accuracy of AI English teaching resource information can reach 100% and the integration time can be shortened to 3S under the cooperation of multi-agents, thus delivering good integration effect and high efficiency.

Keywords: multi-agent collaboration; AI English teaching; information integration; user interest model.

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1 Introduction

English has been paid more and more attention in international communication. English learning has attracted more and more attention (Luo, 2018). The traditional teaching model largely relies professional quality and teaching level, while artificial intelligence can ensure that all the educatees receive the same level of education, and can receive one-to-one guidance from intelligent teachers anytime and anywhere. Using AI technology, a new model is formed (Liang and Li, 2018). Through artificial intelligence

English teaching for personalised learning, from single classroom to diversified learning methods, From online learning to offline integrated teaching, from teachers to self-study. The network multimedia teaching system can recommend the favourite learning materials to users, so that they can determine the learning content according to the learning materials and the learning materials. Therefore, the use of artificial intelligence to realise the integration of English teaching resources and information provides a good learning platform for students (Lin, 2020).

Li (2020) proposed intelligent AI English teaching resources integration method based on mobile technology. It uses B/S structure and three layers of structure for design and development and adopts the mobile internet technology for the client side, which realises the user access to the AI English teaching resources, operations, retrieval and sharing. Ali cloud service technology is used for server, and the unstructured AI English teaching resources platform is constructed. This method has great application value in constructing artificial intelligence English teaching resources. Sun et al. (2020) proposed intelligent AI English teaching resources integration based on Bayesian inference method. It uses AI English teaching involved in demand response as a generalised demand side resources, builds the user preference model, and thus learns the user preferences via Bayesian inference learning, on which the probability estimation in response to AI English teaching resource information is acquired, and the optimal response plan is generated. Finally, an intelligent integration model of AI English teaching resources information is established. However, the accuracy of intelligent integration of AI English teaching resource information in the above two methods is low, leading to unsatisfactory integration effect.

In order to solve the problems of low integration accuracy and long time in the integration of intelligent English learning resources, this paper proposes an intelligent integration technology based on multi-agent. The general technical route is:

1 Aiming at the problems of low integration accuracy and long time in the integration of English intelligent teaching resources, this paper proposes a multi-agent-based intelligent integration technology.

2 Improve the accuracy of intelligent resources and shorten the integration time, the ontology weight is estimated by number of re-entry, content, behaviour, object and time, and the bias intensity of user ontology to a certain field is obtained. The information intelligence integration model is constructed under the cooperation of multi-agent. In this way, AI English teaching resources can be intelligently integrated.

3 This paper compares the intelligent integration technology of teaching resources with Li (2020) and Sun et al. (2020), and compares it with Li (2020) and Sun et al. (2020).

2 Research on intelligent integration method of AI English teaching resource information under multi-agent cooperation

2.1 User interest model construction

User interest is obtained through a series of operations, such as user observation, with AI English teaching digital multimedia. Therefore, the representation of user interest should

be consistent with that of AI English teaching digital multimedia (Liu, 2019; Yuan, 2020; Hughes et al., 2018).

It is supposed that the user have at most N kinds of interest areas, and each interest area is described by ma variety of keywords, then a mone-dimensional vector can be used to describe a user's interest area, and the user's interest model can be described by set S with N m-dimensional vectors. User interest and AI English teaching digital multimedia are both described by vectors, so they can be uniformly processed by vector estimation (Liu, 2021). Therefore, in the absence of original information about the interest, therefore, the original set S is empty. When users are observed to be interested in some AI English teaching digital multimedia application *di*, the vector set S is updated through the description vector V_i of the application $tf * idf$ and the degree of users' interest R_i in the application. The specific process of user interest model construction is as follows.

The original value of the vector set S of the proposed user interest model is empty (Dou, 2018).

Aiming at all the AI English teaching digital multimedia *di* that users are interested in after observing the implicit feedback of users, the following processing is performed:

1 Apply preprocessing to analyse the corresponding documents of the AI English teaching digital multimedia, process the documents in terms of association degree through the language, and then collect the words in the head and title to give them greater weight (Wang et al., 2018).

2 Estimate application *di*'s $tf * idf$ description vector V_i.

3 Estimate the user's interest in application *di*, R_i.

4 Update application *di*'s $tf * idf$ description vector V_i with the user's interest in application *di* R_i.

$$V_i = V_i * R_i \tag{1}$$

where V_i represents the data node and R_i represents the information vector.

5 If $|S| < N$, the total amount of vectors in the user interest model vector set S, let $S \leftarrow S \cup V_i$.

6 Otherwise, a new vector set is formed by the vector in S and the new document vector V_i, and the similarity between the two random vectors in the new vector set is estimated:

$$sim(V_j, V_k) = \frac{V_j \cdot V_k}{|V_j| \times |V_k|},\ j, k \in (1, 2, 3, \ldots, N, i) \tag{2}$$

In the formula, k is the evaluation parameter, $\in$ indicates information increment, and N represents the decision quantity.

7 The two vectors V_l and V_m with the greatest similarity are combined. The calculation of '+' here in V_l is: if a certain word is in V_l and in V_m, then the result of adding the weight of the word in the two vectors is taken as its weight in V_l; if a certain word is in V_m but not in V_l, then the word and its corresponding weight are added to the vector V_l (Cheng and Zhang, 2018).

8 According to the weights in the vector V_l, the words in the vector V_l are sorted in descending order, and the first m types of elements are obtained, and these elements are used as the elements in the vector V_l.

9 So far, the construction of the user interest model is completed.

2.2 Ontology weight estimation

Based on the user interest established above, the weight of user ontology is estimated by the returned number, content, behaviour, object and time, so as to obtain the bias intensity of the user ontology to a certain field (Yuan et al., 2018).

The aim of estimating the weight of ontology is to obtain the intensity of user's ontology bias. The static ontology is stable and the weight can be set to 1. The operation of user interest weight exists in three elements: object, time and content, and the random behaviours mentioned in this study involve number of re-entry, object, content, behaviour, object and time, which can describe the random behaviour of users in more detail. The method is used to estimate the weight of the dynamic ontology, and estimate formula is as follows:

1 Object

Objects are a form of distinguishing users, and different trustworthiness us descried differently. The comprehensive ratio of credibility can be described by the weight of objects, namely:

$$Obj(label) = \frac{Obj_{label}}{\sum_{i=0}^{n} Obj_i} \tag{3}$$

where Obj_i represents the interest weight.

2 Time

Time interval and time stamp are important combinations that exist in time (Lv et al., 2019). The identification of the beginning and completion of the time is described by the time stamp, and the time interval is mainly used to describe the time of the user's reading. Therefore, the expression of the weight $T(label)$ of the time to the dynamic ontology is:

$$T(label) = \frac{T_{i\text{-}end} - T_{i\text{-}start}}{T_{end} - T_{start}} \tag{4}$$

where $T_{i\text{-}end} - T_{i\text{-}start}$ represents the user's online time, and $T_{end} - T_{start}$ represents the browsing time of ontology.

3 Content

The content is an important part of the dynamic ontology and the centre of a random behaviour. It is described by $C(label)$. The dynamic ontology has the maximum threshold of the vocabulary:

$$C(label) = \text{Max}\left(\frac{f_{label}}{\sum_{k=1}^{j} f_{k,j}} \times \log_2 \frac{N}{n_{label}}\right) \tag{5}$$

where f_{label} represents the vocabulary parameter and n_{label} represents the resource information parameter.

4 Behaviour

Behaviour is the user's operations on content, such as bookmarking and browsing. Different random behaviours have different weights, which are described by $A(label)$ and t. The estimation formula is as follows:

$$A(label) = \frac{A_{label}}{\sum_{i=0}^{n} A_i} \tag{6}$$

where A_i represents the data store collection and A_{label} represents the resource parameter.

5 Number of re-entry

The number of re-entry represents the user's attention to AI English teaching digital multimedia, which will greatly interfere with the effectiveness of this random behaviour (Wang, 2018). The expression for the number of re-entry $R(label)$ is:

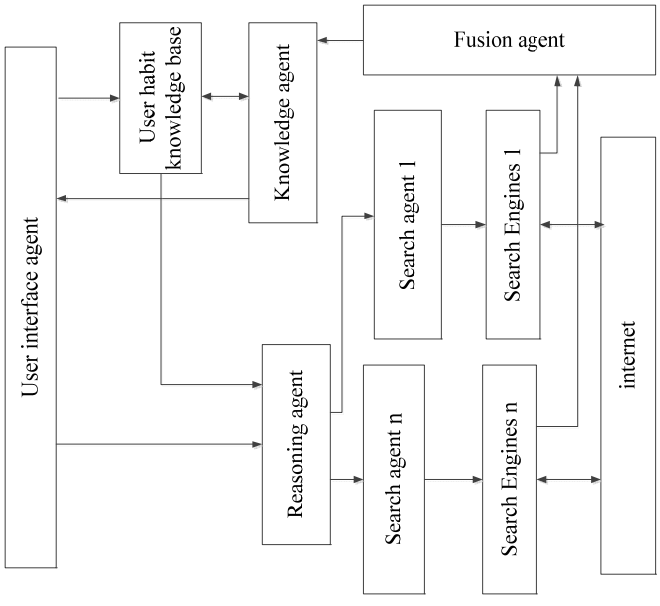
$$R(label) = \frac{R_{label}}{\sum_{i=0}^{n} R_i} \tag{7}$$

where R_{label} represents the number of re-entry in a random manner and R_i represents the total number of user views.

2.3 Information intelligence integration model based on multi-agent cooperation

Due to the large amount of resource information in AI English teaching, the resource data retrieved by traditional means are unstructured data, unable to meet the user's requirements. We must standardise the massive data of English and integrate the massive information of intelligent teaching resources (Wang and Rose, 2020). The integrated model should have certain adaptability and intelligence. A single agent can independently complete specific functions, but for complex and large-scale problems, a single agent is often unable to solve them (Minicozzi, 2018). And cooperation of multiple agents means that multiple agents communicate and cooperate with each other so as to achieve the overall goal. Cooperation of multiple agents has higher work efficiency than the single agent, which requires short time in performing a task, and can solve complex, large-scale problems by integrating scattered, incomplete information together (Chen, 2021). Therefore, this paper constructs an intelligent integration information cooperation of multiple agents. Figure 1 shows the intelligent integration intelligent resources cooperation of multi-agent.

Figure 1 An intelligent integration model of AI English teaching resources information based on multi-agent cooperation



Under the cooperation of multi-agent, AI English teaching resources information intelligent integration model includes user layer, processing layer and retrieval layer. The user layer has the function of interaction. Users interact through the browser user interface agent; the processing layer is the core layer, which processes the user's request intelligently and feeds back the information in the form of knowledge; the retrieval layer is to retrieve the information of AI English teaching resources (Tian, 2021; Shi and Wang, 2019).

The workflow of AI English teaching resources information intelligent integration model under multi-agent cooperation is as follows:

1 When the user interface agent senses that the user has a search request, it will retrieve the resource information according to the user's habit knowledge-base.

2 Start reasoning agent, combining explicit and implicit query requirements according to users' implicit search requirements, and submit them to search agent as processed retrieval requests after normalisation.

3 Each search agent converts the standardised query requirements into the format required by the corresponding search engine, and completes the parallel search of multiple resources of different types through multiple member search engines.

4 The fusion agent will analyse different search results, such as data deduplication, merging, sorting and so on.

5 According to the user's habits, the knowledge-base filters the unmet needs, summarises the relevant results into knowledge, and returns them to the user interface agent together with the URL list.

6 User interface agent searches AI English teaching resource information according to the calculated user ontology bias strength

$$\begin{aligned} people &= \sum_{i=0}^{n} label_i\, p(i) \\ &= \sum_{i=0}^{n} label_i \left\{ \left[Obj(label) + T(label) + C(label) + A(label) + R(label) \right] \times r \right\} \end{aligned} \tag{8}$$

where $label_i$ represents the information label of a certain aspect of the user, $p(i)$ represents the weight of this label, $Obj(label)$, $T(label)$, $C(label)$, $A(label)$, $R(label)$ weights of items of interest in tags, and r express attenuation factor.

7 Present the search results to users in the form of knowledge and accept user feedback.

8 Update the knowledge-base of user habits based on user feedback.

9 Identify the resource attributes in user habit knowledge-base. The information of AI English teaching resources is integrated in Table 1.

The various elements of the resources in the user's accustomed knowledge-base are standardised. The calculation formula is:

$$S = \frac{f * g}{\max(aj)} \tag{9}$$

In formula (9), S resources representing a database, max represents the maximum eigenvector factor representing the aj, f represents the weight of the attribute, and g expressed as a weight vector.

According to the FHO theorem, the resource attributes in the user habit knowledge-base are identified, the weight vector for calculating resource attributes is:

$$D = \frac{z}{\sum_d a * T} \tag{10}$$

In formula (10), D expressed the attribute binding factor, $\sum_d a$ represents the parameter node in the database, T expressed the attribute value, and z expressed the attribute size.

10 According to the identified resource attributes in the user habit knowledge-base, the AI English teaching resource information is integrated.

Firstly, the textbook has been optimised. The basic materials of English teaching materials are provided by teachers. Include name, According to the AI English teaching resource information structure, total assumed N information resources in total, and the sub-carrier bandwidth in the integration A_0. Parameter node $P(B, \beta, X)$, n_0 represents the noise intensity. The information of the artificial intelligence teaching data of English is presented as follows:

$$\mu = A_0 \log\left(1 + \frac{q(n)P(B, \beta, X)}{n_0 A_0}\right)^2 \tag{11}$$

where $q(n)$ represents the sub-carrier power of the information resource integration.

Table 1 realises the intelligent integration method of English teaching resources information, and the actual application effect of the method needs to be further verified through experiment.

Table 1 Content elements of information integration of AI English teaching resources

Essential factor	*Function*	*Example*
Fluid elements	Content attributes of data	Text, video, audio, etc.
Structural elements	Organisational characteristics	Resource integration, metadata architecture, data collection, etc.
Spatial elements	Logical and user views of multiple components	Vector, probability value, etc.
Situational elements	Behaviour details of resource services	Services, events, messages, conditions, actions, etc.
Social elements	Different functions	Administrators, users, etc.

3 Experimental scheme

This paper selects several different teaching resources from the network multimedia resources of English. On this basis, the intelligent integration of artificial intelligence English teaching resources is applied to the information integration of English teaching resources. Table 2 shows the integrated data.

Table 2 Information integration of AI English teaching resources

	Average value	*Standard deviation*	*Variance*
Unified distribution of university journals	4.20	0.84	0.82
Self-access journal	3.2	1.04	1.02
Paper newspapers and magazines	2.5	0.88	0.88
Supporting CD	1.80	1.05	1.22
Self-access to CD	1.56	1.045	1.123
Electronic manuscript	1.58	0.845	0.765

According to Table 2, in the process of information integration of AI English teaching resources, the resource information obtained by this method is relatively high.

3.1 Experimental indicators

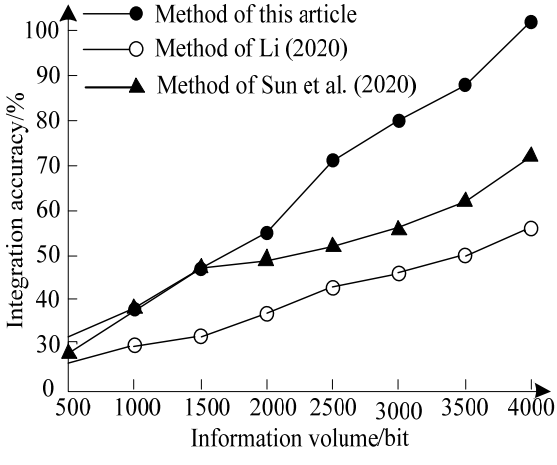
1 Integration accuracy: Different methods were compared in English teaching resources information intelligent integration accuracy. The higher the accuracy, the better the integration effect.

2 Integration time: Different methods were compared in English teaching resources information intelligent integration time.

3.2 Comparison of resource information integration accuracy

This paper compares the correctness of the intelligent integration method of intelligent English teaching resources in the multi-agent collaborative environment, and makes a comparative study with the Bayesian reasoning technology described in Li (2020) and the integration method described in Sun et al. (2020). The comparison results of resource information integration accuracy are shown in Figure 2.

Figure 2 Comparison of the accuracy of resource information integration of three methods

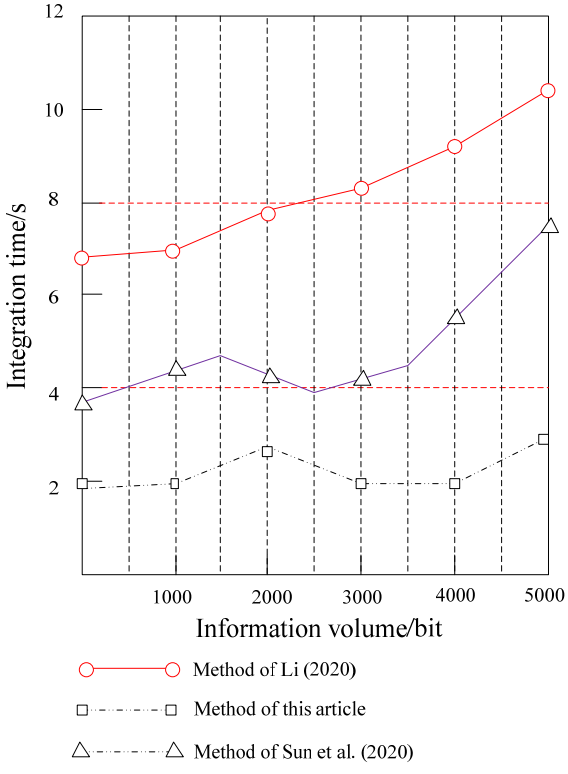


According to Figure 2, the accuracy of AI English teaching resources information integration method proposed in this paper under the cooperation of multi-agent can reach 100%, while the accuracy of AI English teaching resources information integration method based on mobile technology proposed in Li (2020) and integration method based on Bayesian inference proposed in Sun et al. (2020) is only 55% and 70%, respectively. The results show that compared with the integration method described in Li (2020), the integration accuracy of intelligent English teaching resources is higher than the integration method described in Li (2020) and the Bayesian reasoning synthesis method described in Sun et al. (2020).

3.3 Time comparison of resource information integration

In order to improve the effectiveness of testing the intelligent integration technology of artificial intelligence English teaching resources under multi-agent collaboration, a comparative analysis was carried out, the comprehensive method based on mobile technology described in Li (2020) and the Bayesian reasoning described in Sun et al. (2020) combine. The comparison result of resource information integration time is shown in Figure 3.

Figure 3 Comparison results of resource information integration time of three methods (see online version for colours)



According to Figure 3, the intelligent integration time of AI English teaching resources information proposed in this paper is within 3 s, while the intelligent integration time of AI English teaching resources information proposed in Li (2020) is within 11 s, the intelligent integration time of AI English teaching resources based on Bayesian inference proposed in Sun et al. (2020) is within 8 seconds, compared with the other two methods, the intelligent integration time of AI English teaching resources is shortened, which indicates that this method can improve the accuracy of AI English teaching resources information intelligent integration.

4 Conclusions

The traditional method takes a long time in AI English teaching resource information intelligent integration, and its integration effect is not good. Therefore, an AI English teaching resource information intelligent integration method under the cooperation of multi-agents is proposed in this paper. After observing the user's behaviour, and estimate the user's ontology weight according to five factors, so as to obtain the user's preference in a specific field. The five factors include the number of re-entry, content, behaviour, object and time. An AI English teaching resource information intelligent integration model is constructed through cooperation of multi-agents. And obtains the user's

feedback, on which AI English teaching resource information is integrated. The simulation experiments show that the intelligent integration accuracy of AI English teaching resource information under the multi-agent cooperation proposed in this paper is as high as 100%, and the integration time can be 3 s. According to the above, the method in this paper is the best combination of various methods. It is hoped that the integration effect of intelligent integration of English teaching resources and information will be further studied in the future.

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