

Research Article

Design of English Diagnostic Practice Sentence Repetition Recognition System Based on Matching Tree and Edge Computing

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English reading ability is an important indicator to measure learners' English ability. However, because reading ability cannot be directly observed, people usually take tests to judge the reading ability of learners. Therefore, it is very necessary to design a reasonable diagnostic practice sentence repetition recognition system to analyze and test, inform learners of the advantages and disadvantages in reading, and give corresponding countermeasures. In order to properly solve the problem of repeated recognition of English diagnostic sentences, we have developed a new recognition system combined with matching tree and edge computing technology. First, the matching tree algorithm is used for the repetitive diagnosis of English sentences. The algorithm has achieved good results in the repetitive diagnosis and matching. Secondly, an English diagnostic practice sentence repetition recognition system architecture is built through edge computing algorithms, which improves the efficiency of the English diagnostic system. Finally, through the simulation test of the English diagnostic practice system, the applicability of the established repeated recognition model is verified.

1. Introduction

Testing is an essential part of language teaching. According to different purposes, language tests can be divided into diagnostic tests, proficiency tests, ability tests, placement tests, etc. Compared with other types of tests, the relationship between diagnostic tests and teaching is closer [1, 2]. If properly designed, it can provide teachers with detailed feedback information, which is of great significance to language teachers and learners [3, 4]. However, due to the existence of test-oriented education, the development of diagnostic tests has not attracted enough attention [5]. Especially because of the existence of test-oriented education, the development of diagnostic testing has been neglected, so its development is particularly important. In addition, listening ability has always been an important part of language ability [6]. With the development of computers and the Internet, in various public tests at home and abroad, many listening tests are trying to use online listening tests. Traditional listening tests are gradually being replaced by online listening tests [7, 8].

At present, most college students lack the ability to self-study under the influence of self-study, traditional classroom

teaching, and test-oriented education mode. And the dependence on teachers is still very strong. The contradiction between the increasing number of students and the shortage of teaching resources makes students urgently need to improve their self-learning ability [9, 10]. The improvement of computer network technology and teaching facilities has injected new vitality into college English teaching and learning. With its unique novelty, interactivity, and visibility, it attracts all students in the university and provides unprecedented advantages [11, 12]. It is a computer-based Internet technology requirement (trial version) proposed in the college English course, student-centered autonomous learning, focusing on general English ability, especially listening and speaking ability, emphasizing the importance of formative evaluation develop in the direction of learning personality and self-direction, teaching students to establish a dominant position in the process [13, 14]. At present, many universities in China have used broadband transmission technology to establish campus networks, thereby providing favorable conditions for universities to train foreign language talents. How will powerful media or the Internet serve language teaching on the Internet? One of the possible methods is online

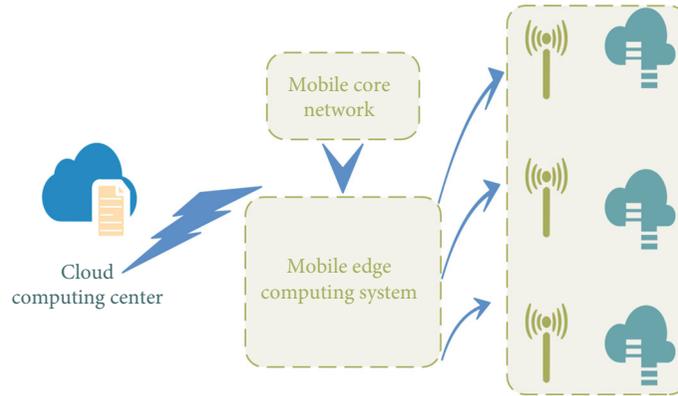


FIGURE 1: Schematic diagram of the value chain model of mobile edge computing.

testing. The online English test supplements the traditional language test, which is also a developmental language test of the traditional language. The organic combination of the two will communicate with each other in modern EFL teaching. Language testing is an important aspect of teaching in the learning process [15].

Previous studies mostly focused on analyzing the problems of learners in reading and did not put forward the advantages of learners in reading. At the same time, there are very few studies on these problems that give learners corresponding feedback. Therefore, it is very necessary to design a reasonable diagnostic practice sentence repetition recognition system to analyze and test, inform learners of the advantages and disadvantages in reading, and give corresponding countermeasures. In order to properly solve the problem of repeated recognition of English diagnostic sentences, we have developed a new recognition system combined with matching tree and edge computing technology. The matching tree algorithm and edge computing technology will be used in the model establishment and architecture design of the English diagnostic practice system. The improvement of computer network technology and teaching facilities has injected new vitality into college English teaching and learning. With its unique novelty, interactivity, and visibility, it attracts all students in the university and provides unprecedented advantages.

2. Overview of Related Technologies

2.1. Edge Computing. Traditional cloud computing can solve the core computing tasks of the network. However, with the continuous increase of data in the cloud, the transmission delay, and calculation delay of the cloud will be challenged [16, 17]. The fundamental problem of cloud computing is the higher service delay and intermittent connection between mobile devices and cloud servers, which may not be able to meet the real-time services of different emerging applications, such as augmented reality and online traffic monitoring systems [18, 19]. Therefore, with the advancement of information technology, data communication, sensing, processing, and control are transforming the transportation system from a traditional technology-driven system to a more powerful data-driven intelligent transportation system. Edge

computing is a computing architecture that allows execution at the edge of the network [20]. It needs to sink the work of server computing to the edge of the network. Generally, there are three roles for devices in edge computing: terminal devices, edge servers, and cloud servers. Terminal devices are generally devices with network communication capabilities at the edge of the network. For example, for individual users, the terminal devices are mobile phones, laptops, and tablets. A schematic diagram of the value chain model of mobile edge computing is shown in Figure 1.

Mobile edge computing helps to realize the edge cache function and improve the current low efficiency of mobile content distribution. Based on the MEC server, wireless analysis applications can be deployed at the edge of the wireless access network to provide content servers with wireless environment information (such as real-time throughput of wireless links) [21, 22]. Using this type of information, the content server can perform more reasonable control over content transmission and content encoding (for example, online video) and match the transmission content with the wireless link capacity.

2.2. English Diagnostic Exercises. Since word recognition and language comprehension capabilities make important meaning independent of their contribution to reading ability, based on this research, the speech efficiency theory (VET) proposed by Perfetti in 1985 was adopted [23]. Perfetti's model emphasizes the importance of low-level accuracy and rapid word recognition and high-level language comprehension, which are part of improving reading progress. It explains that Automatism Theory (AT) reading is a complex process, in which simultaneous word recognition and obsessive-compulsive disorder can only occur when they show comprehensive cognitive needs. The document will not exceed the reader's available resources [24]. Interaction between English listening and speaking-source is shown in Figure 2.

Knowledge is divided into two categories: language knowledge and other related knowledge (social knowledge, personal experience, and background) and psychological activities of listening comprehension [25]. If a learner tries to improve his level, foreign language listening comprehension must go through three stages, namely voice recognition,

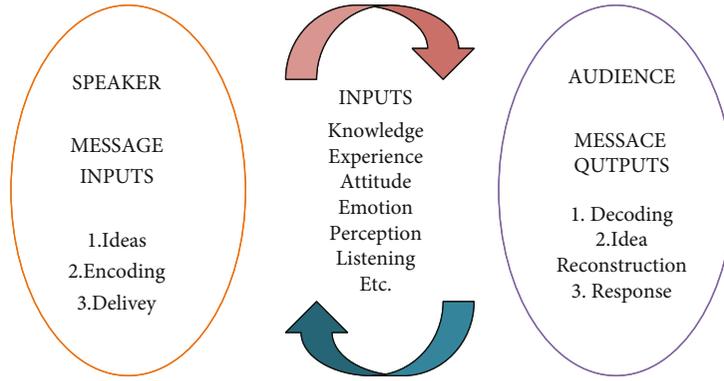


FIGURE 2: Interaction between English listening and speaking-source.

sentence comprehension, and paragraph comprehension. Rivers believes that foreign language listening comprehension includes two levels of speech activity recognition and selection. It has a guiding guide for understanding listening comprehension and development. Used in listening comprehension testing and teaching. For beginners' listening comprehension, test more materials related to sound recognition. For intermediate or advanced personnel, choose the sentence in the listening test [26].

Only when readers recognize words quickly and automatically without using a lot of attention resources, they can make full use of most of their attention resources to achieve successful reading ability. Although VET also focuses on the automation of decoding, this is different from AT [27]. VET expands the concept of the underlying decision-making process. They provide interesting reprinters of the relationship between word recognition and reading comprehension with different perspectives. According to Tracy and Morrow, VET is based on three assumptions: the learner's reading of a printed text is regarded as their final hearing of the text; the time the reader spends reading an isolated word indicates the reader's understanding of the word, and the reader's decoding ability is the main source of determining its word recognition.

3. English Diagnostic Practice Repetitive Sentence Recognition Based on Matching Tree

The diagnostic evaluation module of the current system is the early design of the system, and does not consider aspects of learning status, knowledge point correlation analysis, question type correlation analysis, four-level score prediction, etc. [28].

The learning guidance for learners is very limited, and it cannot be personalized study suggestions. Therefore, this chapter first analyzes and designs the diagnostic evaluation model and then preprocesses the data collected when the system is used. The three dimensions of learning status evaluation, question type association analysis, and college English four-level score prediction are modeled separately. Finally, after combining these submodels, a relatively complete and reliable diagnostic evaluation model was obtained, and related verification was carried out [29].

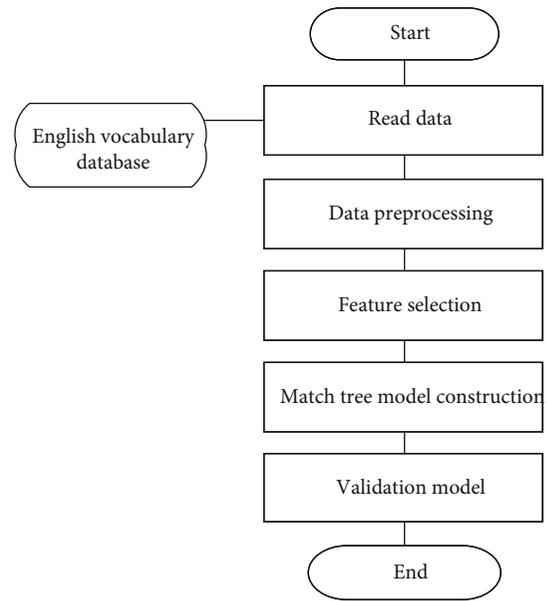


FIGURE 3: Recognition of repetitive sentences in English diagnostic exercises.

The matching tree algorithm first preprocesses all subscription collections into a tree. After the message arrives, it traverses the established tree to find matches between all messages and events. Its core is the matching tree. Figure 3 shows a tree with two subscriptions S1 and S2. The edge represents the test result, while the nonleaf node represents a test. The subscription conditions that need to be matched are associated with the leaf nodes.

$$f = f(x). \tag{1}$$

Constraints:

$$\begin{aligned} x'_j &\leq x_j \leq x'_j \quad (j = 1, 2, \dots, n), \\ g_j &\leq g'_j \quad (j = 1, 2, \dots, n), \\ h'_j &\leq h_j(x) \quad (j = 1, 2, \dots, n), \\ w'_j &\leq w_j(x) \leq w'_j \quad (j = 1, 2, \dots, n). \end{aligned} \tag{2}$$

X represents the test edge, which represents the subscription that can be reached through X , where the edge does not care about the test result. Such subscription is a predicate that contains leaf nodes.

$$Q(x, q) = \frac{f}{f_0} + \sum_j p_x(x_j) + q \left[\sum_j p_g(g_j) + \sum_j p_h(h_j) + \sum_j p_w(w_j) \right], \quad (3)$$

in which p_x, p_g, p_h , and p_w are a penalty factor for constrained design variables and state variables. By using the gradient method for unconstrained optimization problems, the iterative formula is expressed as follows [30].

$$x^{(j+1)} = x^{(j)} + s_j d^{(j)}. \quad (4)$$

When algorithms are matched, in order to be able to quickly respond to query requests, we usually build indexes. Through the index, when responding to query requests, the system can quickly find the needs of users. The index establishes a mapping relationship between information and content storage location information. The information index is divided into the forward index and inverted index [31, 32].

$$\begin{aligned} |f^{(j)} - f^{(j-1)}| &\leq \tau, \\ |f^{(j)} - f^{(b)}| &\leq \tau. \end{aligned} \quad (5)$$

The forward index is expressed in the form of “document-keyword,” and the position information of each keyword in the document is recorded in the table.

$$D(v) = \sum C(v_i, v_j), \text{ where } v_i, v_j \in V. \quad (6)$$

When searching, scan the words in each document in turn according to the document number, and output all matching keywords. The establishment process and organization of the positive index are relatively simple and easy to maintain. However, all matching conditions must be scanned when querying, which results in a long response time and low efficiency.

$$D(v_0) \leq D(v_1) \leq D(v_2) \leq \dots \leq D(v_n). \quad (7)$$

The design idea of the inverted index is the catalog, and we can quickly find the specific location of the content through the catalog. The structure of the directory is <key, address>. In order to be able to match quickly, we set a keyword whose structure is the directory of <keyword, address>, which we call an inverted index.

$$D(v_{n+1}) = \min \{D(v_n) + C(v_i, w)\}, \text{ where } v_i \in U, w \in V - U. \quad (8)$$

In the inverted index, the word in the document is used as the “directory” keyword, and the document number where

the word appears is used as the storage address, that is, <word, key>. Generally, a word will appear in multiple documents or one or more times in a document. Therefore, the address in the “directory” is a list of document numbers. Each item in the list contains information about all the locations where the word appears in the document.

4. Case Verification of Repetitive Sentence Recognition in English Diagnostic Exercises

Based on the fast-matching algorithm of multilevel constraint search tree, this paper designs the matching mechanism of pub/subsystem based on inverted index. The fast-matching algorithm of multilayer constraint search tree reduces repeated matching through constraint coverage when one event matches multiple subscription conditions. However, there are still many repeated matching problems when multiple events match multiple subscription conditions. In order to solve this problem, by introducing an inverted index based on a multilayer constrained search tree, an efficient matching mechanism suitable for the parallel interaction of large-scale publishers and subscribers is constructed. The inverted index is used to analyze the coverage relationship between subscription conditions and events, which reduces the number of matching subscription conditions and events and further improves matching efficiency.

4.1. Technical Performance Test. At present, due to the existence of test-oriented education, the development of diagnostic tests has not attracted enough attention. Especially because of the existence of test-oriented education, the development of diagnostic testing has been neglected, so its development is particularly important. In addition, the listening ability has always been an important part of language ability. With the development of computers and the Internet, in various public tests at home and abroad, many listening tests are trying to use online listening tests, and traditional listening tests are gradually being replaced by online listening tests.

In Figure 4, the inverted index and the multilevel constraint search tree fast matching algorithm are applied to a large-scale subscription condition matching model. The specific construction algorithm of the model is as follows: (C1) Statistical analysis of the subscription conditions in the system, using the inverted index. The algorithm constructs an inverted index structure based on “constraint-subscription,” which is aimed at quickly tracing back to the subscription conditions through constraints. (C2) Statistically analyze the events in the system and use the inverted index algorithm to construct an inverted index structure based on “attribute-event,” aimed at quickly tracing back to events through attributes.

4.2. Comparison of Matching Tree Algorithm and Other Algorithms. Figure 5 shows the relationship between time delay and energy loss. Different θ has different proportions of time delay and energy loss. As the value of θ continues to increase, the proportion of time delay in the main problem

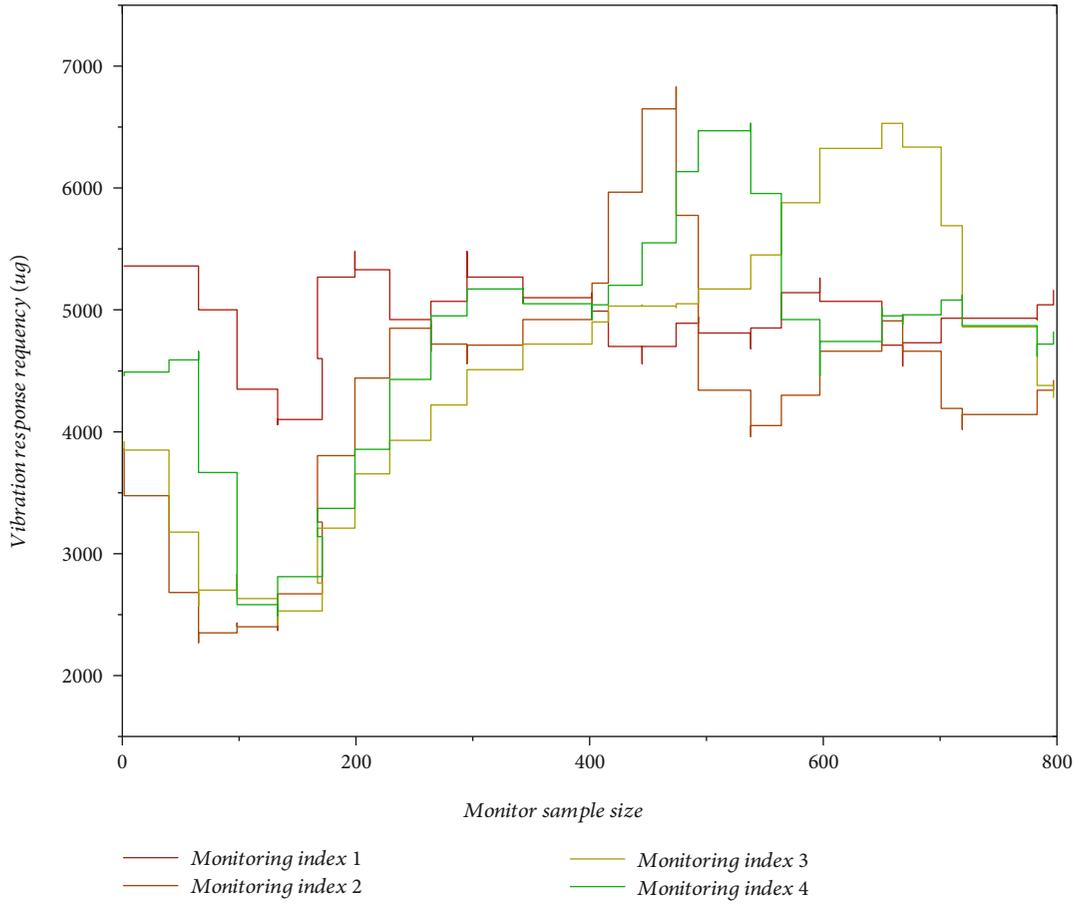


FIGURE 4: English diagnostic exercise matching model test based on an inverted index.

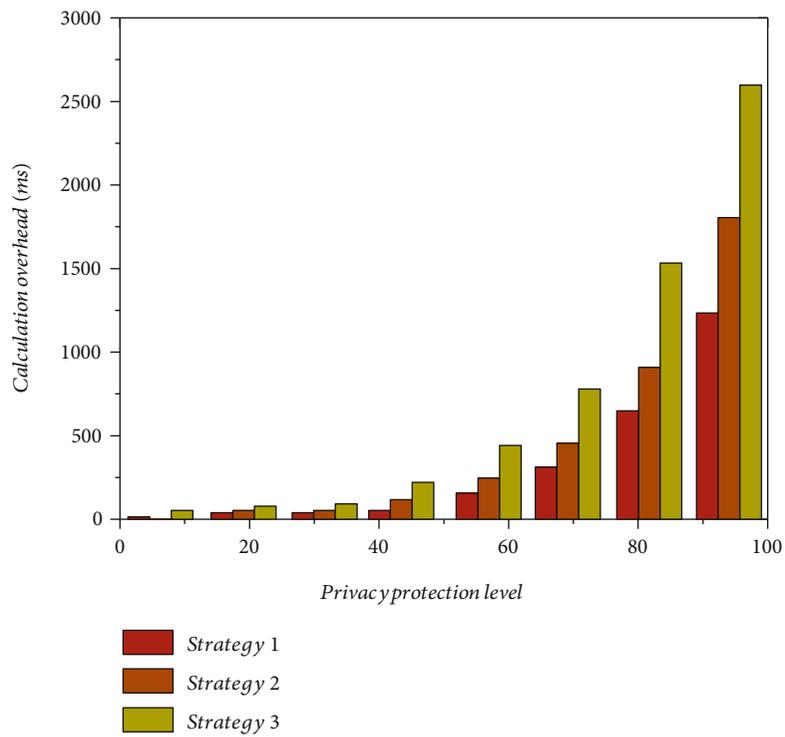


FIGURE 5: Comparison of the delay of matching tree algorithm with other algorithms.

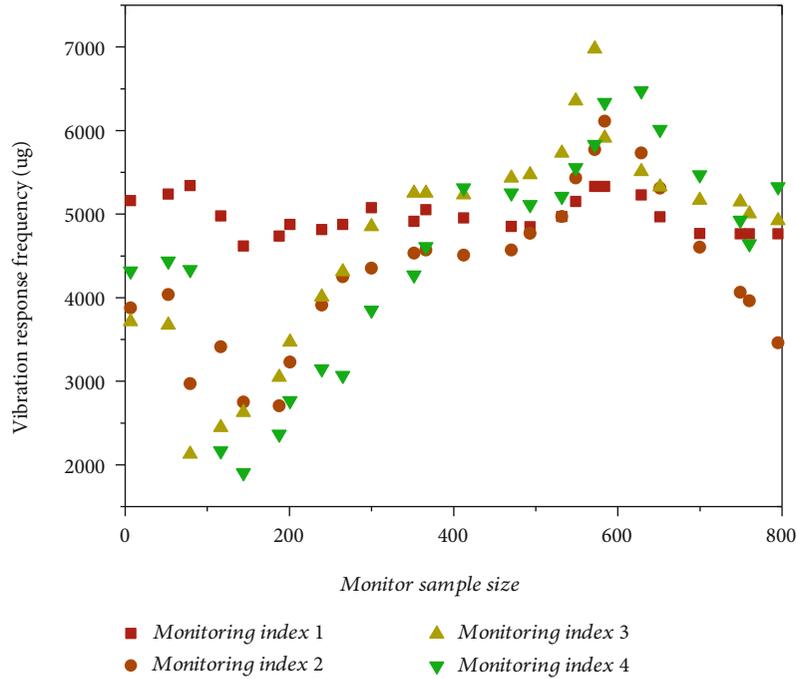


FIGURE 6: Comparison of edge computing power consumption for English diagnostic exercises.

continues to increase, and the proportion of energy loss continues to decrease.

When $\theta = 0$, it means that the time delay problem is not considered in the unloading process, so the value of the objective function depends largely on the energy loss value, which is an energy-optimal unloading algorithm. When $\theta = 1$, it means that we do not consider the energy loss during the unloading process and focus on the delay problem, but it will still produce energy loss to the terminal equipment. The objective function value not only depends on the delay but also considers the energy loss. Therefore, it can be found from Figure 5 that energy loss and time delay are inevitable during the unloading process.

Figure 6 shows the relationship between the power consumption comparison of edge computing in English diagnostic exercises. This paper studies the optimal task offloading strategy of delay and energy consumption and deploys an effective priority task scheduling algorithm on the edge server, targeting vehicles. For the complex and diverse messages generated by the terminal, we adopt a message priority division algorithm, so that emergency messages of different priority levels can be processed in different ways. Therefore, the emergency messages of each priority level have different processing delays.

5. Conclusion

The results of the research prove that compared with the traditional diagnostic online hearing test, it can play a timelier diagnostic role, so that it can quickly and accurately feedback test information. Teachers can adjust teaching in time based on feedback information to improve teaching quality.

Despite its limitations, the online diagnostic hearing test system is still a test method with great development and application prospects. English reading ability is an important indicator to measure learners' English ability. However, because reading ability cannot be directly observed, people usually take tests to judge the reading ability of learners. Therefore, it is very necessary to design a reasonable diagnostic practice sentence repetition recognition system to analyze and test, inform learners of the advantages and disadvantages in reading, and give corresponding countermeasures. The matching tree algorithm and edge computing technology will be used in the model establishment and architecture design of the English diagnostic practice system. The improvement of computer network technology and teaching facilities has injected new vitality into college English teaching and learning. With its unique novelty, interactivity, and visibility, it attracts all students in the university and provides unprecedented advantages. In the future, we will collect more experimental data to optimize the matching tree algorithm based on the diagnostic evaluation model, and improve the repeated recognition of English diagnostic contact sentences.

Data Availability

The authors approve that data used to support the finding of this study are included in the article.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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