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The Language Characteristics of Internet of Things English from the Perspective of Word Formation

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Abstract: IoT English is part of Tech English. Therefore, IoT English also has the characteristics of strict standardization, strong objectivity and strict logic. However, due to the uniqueness of IoT science, IoT English has some characteristics that are different from other technical English, which is also different from the commonly applicable “ordinary English”. Therefore, in the process of developing the Internet of Things, this paper explored the English of IoT from the perspective of word meaning to address the heterogeneity and interoperability of the Internet of Things, as well as interoperable collaborative systems. By analyzing language features, semantic synergy was finally realized. However, since the semantic Internet of Things has the dual characteristics of the Internet of Things and the semantic web environment, the semantic data in it presents many new data characteristics. These semantic capabilities are also compatible with semantic IoT, which requires the data ability to analyze semantic data in the semantic Internet environment to make the most of semantic data. For these functions, this paper proposed a QoS-based method of dynamically combining IoT semantic services to provide semantic information, and various service seekers in the IoT environment provide dynamic and more accurate services. Also, it presented the experimental results of traditional semantic matching similarity comparison. The recall and accuracy rates were 50% and 56.7%, respectively. At the same 175 nodes, the improved S-Match improved the response time of the S-Match by 135 milliseconds, and it can be seen that the system is highly viable.

1. Introduction

1.1 Background

With the rapid development of IoT technology, various information retrieval technologies have been widely used, and communication between devices has become the key to studying IoT technology and how to transform data and objects into the real world. Semantic technology is undoubtedly the research focus of IoT technology development, and it is very important to enhance people's awareness and build a global collaborative ecosystem. In short, data is a symbol, and a simple symbol by itself means nothing. Currently, data has been transformed into information. A particular concept is semantics, and the purpose of semantic technology is to capture the semantics of data through natural language processing, data mining, and other techniques to capture the true meaning of the data so that machines can understand and use it. As people's cognitive abilities and states continue to change, the demand for ontology is increasing, and at the same time, the number of ontology is also increasing rapidly, and the above methods alone are not sufficient. The more important question to be solved is how to improve the lack of expressive power, confusion of expression and semi-decidability of the final system of traditional logic, so that the computer can maintain the effective sustainability of reasoning (the computability of logical formulas) , is one of the key issues that must be solved by semantic collaboration.

1.2 Significance

Semantic IoT aims to integrate objective entities, detector devices, information transmission media, and application analysis systems in the physical world to create a global collaborative ecosystem that forms a collaborative interconnected system. Among those things that exist in the development process, they are developing in the direction of intelligence, and the direction of intelligence actually realizes the expansion of human perception. Problems and unclear processes and services are effectively resolved, and the interconnection of various terminals in the IoT world and the intelligent analysis and decision-making of the management platform are practically realized. In the Semantic Internet of Things, it not only has the ability to express simple knowledge, but also has the ability to express general knowledge; in terms of interactivity, the semantic matching system for the Semantic Internet of Things is given a dynamic architecture, thereby enhancing its ability to process general knowledge; In terms of data sources, it is not only transmitted through sensors, but also obtains data from user-defined, mature ontology, etc., to provide upper-level reasoning: In terms of semantic reasoning, research on semantic matching algorithms and systems provides the basis for intelligent information services such as knowledge acquisition and information retrieval; In terms of semantic services, according to the high-level semantic information introduced by the algorithm, it can provide the most suitable services for user discovery, selection and other situations.

1.3 Related Work

With the sudden outbreak of COVID-19, the proliferation of new words and phrases has created new vocabulary and sociolinguistic changes that have become part of our lives. The emergence of the COVID-19 outbreak has increased significantly to establish a trend base for new words worldwide. The Al-Salman S study seeks to investigate the nature of new English words and expressions emerging in the wake of the COVID-19 crisis. It also identified the type of word formation process that led to the appearance of these new words in English. The analysis shows that word formation processes are diverse, covering all possible derivation forms, including affixes, compounds, mixtures, cuts, acronyms, etc., as well as double-reconstruction word processes, where compound and mixture are the most discrete [1]. Although his research is cutting-edge, it has certain limitations to the new English that emerged after the COVID-19 crisis. Dimaculangan NG study shows a meta-analysis of the word-formation process framework used by English-speaking Filipinos. It presents these processes in the creation of the Philippine English (hereafter PhilE) dictionary since the 1970s, and demonstrates that the formation of the Philippine English vocabulary dances creatively over time. The limited research on this paper from 1973 to 2015 shows interesting lexical items created through existing L1 English word formation processes. Selected from early 21st century works, the Filipino English vocabulary project was formed through existing word formation processes, and through creative expansion or modification of these processes, intentionally integrating such as anagrams, metonymy, onomatopoeia, self figures of speech such as contradictions and puns [2]. Although he proposes an ad hoc composite modification framework adopted from all existing L1 English and ESL various frameworks investigated in this study, there are still no closures in the experimental data. The Internet of Things (IoT) is rapidly changing the interaction between people and technology. Qin X research demonstrates the potential of IoT to be efficient, and IP-based wireless sensor networks (WSNs) still have widespread use, challenging some aspects of security warnings. While based on a strict radial vision design, VisIoT can open the door to the enemy for wireless sensor networks, but IP-enabled or more simultaneous attacks.

1.4 Innovation Points

The innovation of this paper lies in (1) the dynamic composition method of semantic IoT service based on QoS, based on the QoS ontology of adding context. (2) A prototype system of dynamic composition of QoS-based semantic IoT services is designed and implemented. According to the corresponding reasoning mechanism, the ontology and knowledge base are represented, and according to the corresponding improved S-Match algorithm and the computability logic CL4 algorithm, the relationship between the ontology is obtained by reasoning, and it provides support for other ontology applications.

2. Research Methods of Language Characteristics of Internet of Things English

This research combines practical induction and theoretical deduction in specific methods, and makes an overall and specific description and induction of "the language characteristics of Internet of Things English". In the research process, the literature analysis method, comparative research method, theoretical deduction method, Induction and information systems analysis methods[3].

2.1 IoT Technology

The IoT is actually a fusion of the Internet with RFID, various sensors (such as environmental sensors, service terminals) and the surrounding smart things. It carries out information interaction between people and things, and realizes intelligent identification, positioning, tracking, monitoring and management. The IoT application is shown in Figure 1.

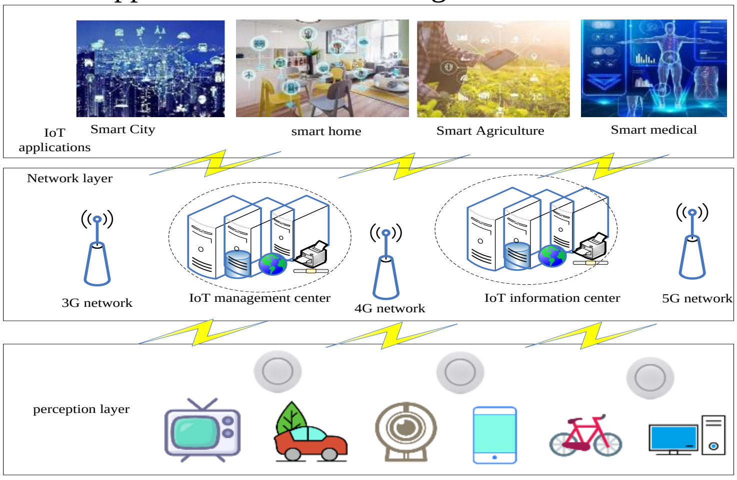

Figure 1: IoT applications

As shown in Figure 1, the IoT has been widely used in various fields, such as smart cities, smart homes, smart agriculture, smart medical care, and smart transportation. The innovation of IoT will drive the development of technology and can provide huge economic benefits, but it also faces many serious challenges. The challenges currently faced by the IoT mainly include the following two aspects . First of all, in terms of security and privacy, the security and privacy of information and networks should have basic characteristics such as confidentiality, integrity, and availability. The IoT will be applied to the most important economies in the world, such as transportation, medical care, cities, households, personal and social aspects. Therefore, security and privacy issues are the most to be addressed in IoT. Second, the applicable aspect of the network protocol, the IoT may connect a large number of objects, which will generate a large amount of traffic and require a large amount of data capacity.

2.2 Literature Research Method

The literature research method is a research method to find out the essential attributes of things by consulting the literature, analyzing and sorting out on this basis [4-5]. In the research process of this paper, the comprehensive and systematic collection, arrangement and analysis of the research results of the Internet of Things education supporting education and teaching reform at home and abroad provide reference for this research [6-7]. By carrying out systematic and in-depth literature research, it is helpful to comprehensively and systematically grasp the history and current situation of the proliferation of the Internet of Things in the field of English education, sort out the relevant discourses on the education concept in the Internet of Things era at home and abroad, and grasp the use of Internet technology at home and abroad to support education and teaching reform. The typical cases and successful experiences of the Internet of Things education, to understand the practical status and development direction of IoT education supporting personalized learning and innovative talent training, and to provide support for this research through the analysis and evaluation of existing literature.

2.3 Comparative Research Method

The comparative research method is a method of comparing and contrasting the development of the research objects in different periods and different regions, through the phenomenon, revealing the essence, analyzing the similarities and differences, and finding common and special laws [8-9]. The most important thing in comparative research is to have a certain understanding and research on the two parties or parties involved in the comparative research, and to "see the similarities in the differences and the differences in the same" through comparison, and find the rules[10-11]. By comparing the characteristics of traditional education in the above aspects with Internet education, it is demonstrated that IoT education is participating in the reform of future education and has become an important educational form to promote educational reform.

2.4 Theoretical Deduction Method

The deductive method is to observe and study the special objects with the known general principles, and infer the conclusions about the things. Deductive method is an important research method in scientific research. It can not only expand and deepen existing knowledge, but also scientifically foresee the future and provide forward-looking clues for new discoveries [12-13].

3. Dynamic Composition of Qos-Based Semantic Iot Services

In order to more efficiently select and combine services in the service library according to user-perceived context information and QoS constraints, it is necessary to preliminarily screen services to obtain candidate service sets [14-15]. Figure 2 describes the composition and working principle of Semantic IoT.

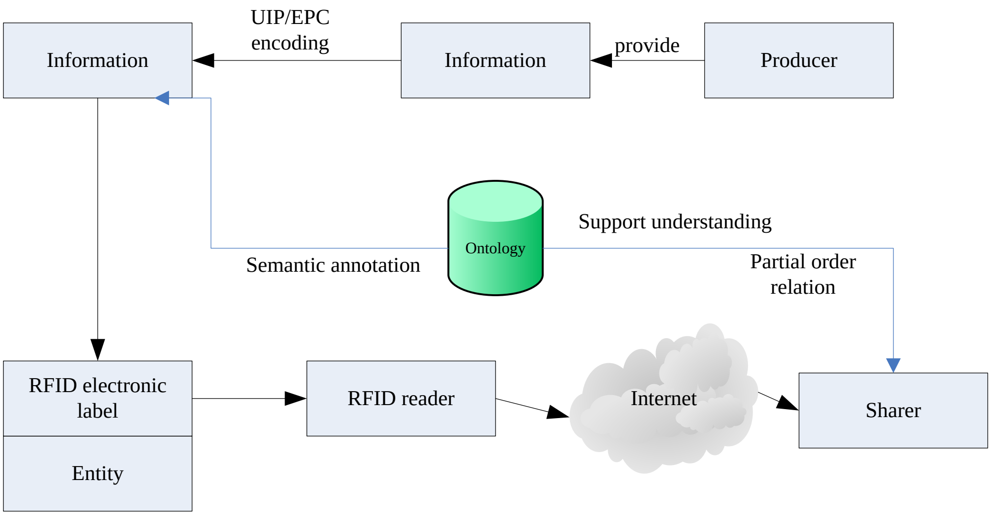

Figure 2: Composition and working principle of Semantic IoT

As can be seen from the description in Figure 2, its working principle is as follows: the information source of the object is provided by its producer, and it is standardized by the encoding method (UIP/EPC encoding), and the encoded information is saved to the radio frequency In the label, the information of the object can be obtained by machine with the help of a special code reader.

3.1 Building a Fuzzy Neural Network Model

This section first introduces the development history of neural network and fuzzy logic theory and their respective characteristics, and then expounds the mathematical conceptual model and learning simulation algorithm of TS neural network. theoretical basis.

(1) Artificial neuron model

Biological neurons generally include cell bodies, axons, dendrites and synapses, which complete the reception and processing of information, and are mapped in a certain interval (usually zero to one or minus one to one), here refers to the activation function function, such as step function, linear partition function and threshold function, etc. The above is represented by formula (1).

$$\mu_k = \sum_{j=1}^{p} w_{kj}x_j, v_k = net_k = u_k - \theta_k, y_k = \varphi(v_k) \tag{1}$$

(2) Training of artificial neural network

The collection and preprocessing of information is a key part of successfully developing a neural network. First of all, the input quantity must be determined, that is, the correlation between the input quantities must be tested (when there are two input quantities with strong correlation, the data needs to be analyzed. After statistical analysis, select one of them as the input), if you set up more nodes at the beginning, you need to use the error cost function after the network training:

$$J_f = \frac{1}{2}\sum_{p=1}^{p}\sum_{i=1}^{N_q}(t_{pi} - x_{pi})^2 + \varepsilon\sum_{q=1}^{q}\sum_{i=1}^{N_q}\sum_{i=1}^{N_{q-1}}|w_{ij}^{(q)}| = J + \varepsilon\sum_{q,i,j}|w_{ij}^{(q)}| \tag{2}$$

In the formula, J_f is the sum of the squares of the error output, and the second term, in order to minimize the connection weight coefficient after training, is generally called the "forgetting term", and the learning algorithm is obtained by letting the J_f calculate the gradient of the w_{ij}. The gradient is as follows

$$\frac{\partial J_f}{\partial w_{ij}^{(q)}} = \frac{\partial J}{\partial w_{ij}^{(q)}} + \varepsilon \mathrm{sgn}(w_{ij}^{(q)}) \tag{3}$$

If only a single hidden layer is included in the forward network, the relationship between the number of neurons in the input layer M and the number of nodes in the layer q is approximately

$$q = 2M + 1 \tag{4}$$

The performance of a network is mainly measured by its generalization ability, which is tested and verified with a set of independent data.

(3) Fuzzy controller

For the MISO (multiple input single output) structure, the discrete-time model can be represented by a set of m fuzzy rules, where the jth fuzzy rule is as follows:

$$R^i\text{: if } x_1 \text{ is } A_1^i, x_2 \text{ is } A_2^i, \ldots, x_m \text{ is } A_m^i \text{ then } y^i = p_0^i + p_1^i x_1 + p_2^i x_2 + \ldots + p_m^i x_m \tag{5}$$

Among them, X_j becomes the generalized input variable of the model, and the membership function of the fuzzy subset is a convex set composed of pieces. If a generalized input variable $(x_{10}, x_{20}, \ldots, x_{m0})$ is given, then the output y^i(i=1,2, ..,.n) can be obtained by the weighted average of the output $\overline{y}$ of the rules

$$\overline{y} = \frac{\sum_{i=1}^{n} G^i y^i}{\sum_{i=1}^{n} G^i} \tag{6}$$

n is the number of fuzzy rules; y^i is obtained by the conclusion equation of the ith rule; the weight G^i represents the truth value of the ith rule corresponding to this generalized input vector, which is determined by:

$$G^i = \prod_{j=1}^{m} A_j^i (x_{j0}) \tag{7}$$

Here Π is a fuzzy operator, usually using a small operation or a product operation.

(4) MIMO system structure

The MIMO system structure is a further derivation of the MISO system principle compared to the MISO structure principle. Each node of the first layer of the front piece network is connected to each component x_i of the input $\overline{x} = [x_1, x_2, \ldots, x_n]^T$ vector, and this layer is used as the input layer to transmit the input value. To the second layer above, the second layer mainly completes the membership degree μ_i^j of each component x_i of the input, that is

$$\mu_i^j = \mu_{A_i^j}(X_i) \text{ or } \mu_i^j = e^{\frac{(x_i - c_{ij})^2}{\sigma_{ij}^2}} \tag{8}$$

where c_{ij} and σ_{ij} are the center and width of the function, respectively;

$$\alpha_j = \mu_1^{i1} \mu_2^{i2} \cdots \mu_n^{in} \tag{9}$$

In the formula, $i_1 \in \{1,2,...,m_1\}, i_2 \in \{1,2,...,m_2\} ... i_n \in \{1,2,...,m_n\}$,j=1,2,...,m,m=$\prod_{i=1}^{n} m_i$, the role of the fourth layer is to normalize the calculation, that is

$$\overline{\alpha_j} = \frac{\alpha_j}{\sum_{i=1}^{m} \alpha_i} \text{ (j=1,2,...,m)} \tag{10}$$

The first layer of the postware network is also the input layer, and its zeroth node mainly provides the constant term of the network, so its value is 1. The second layer deals with the consequent of each rule, namely

$$y_{ij} = p_{j0}^{i} + p_{j1}^{i}x_1 + \ldots + p_{jn}^{i}x_n = \sum_{l=0}^{n} p_{jl}^{i}x_l \ (j = 1,2,\ldots,m; i = 1,2,\ldots,r) \tag{11}$$

The calculation output of the network is realized in the third layer. When calculating the output, the output of the preceding network is used as the weighting coefficient, and the output value is the weighted sum. At this time, the MIMO system structure model is realized, that is,

$$y_i = \sum_{j=1}^{m} \overline{\alpha_j}\, y_{ij} \quad (i = 1,2\ldots,r) \tag{12}$$

3.2 Build the t-s Network Model

Through the previous introduction to the development history of neural network, artificial neural network model and unit training, and in-depth analysis of the learning algorithm of fuzzy control theory, when the TS fuzzy neural network is initialized, the membership function is determined according to the indoor environment data required for training. coefficients, parameters, and then use the MapMinMax function to normalize the training data, such as

$$y = (y_{max} - y_{min}) * (x - x_{min})/(x_{max} - x_{min}) + y_{min} \tag{13}$$

In the formula, y_{max} is generally 1, y_{min} is -1, and x_{max} and x_{min} are the maximum and minimum values of the input, respectively. Let the error cost function be $E=\frac{1}{2}\sum_{i=1}^{r}(t_i - y_i)^2$, t_i and y_i represent the expected output and the actual output, respectively. The following is the parameter p_{ij}^{l} learning algorithm:

$$\frac{\partial E}{\partial p_{ij}^{l}} = \frac{\partial E}{\partial y_1}\frac{\partial y_1}{\partial y_{lj}}\frac{\partial y_{lj}}{\partial p_{ij}^{l}} = -(t_1 - y_1)\overline{\alpha_i}x_i \tag{14}$$

$$p_{ij}^{l}(k+1) = p_{ij}^{l}(k) - \beta\frac{\partial E}{\partial p_{ij}^{l}} = p_{ij}^{l}(k) + \beta(t_1 - y_1)\overline{\alpha_i}x_i \tag{15}$$

At this point, the parameter p_{ij}^{l} can fix the T-S fuzzy neural network structure as shown in Figure 3:

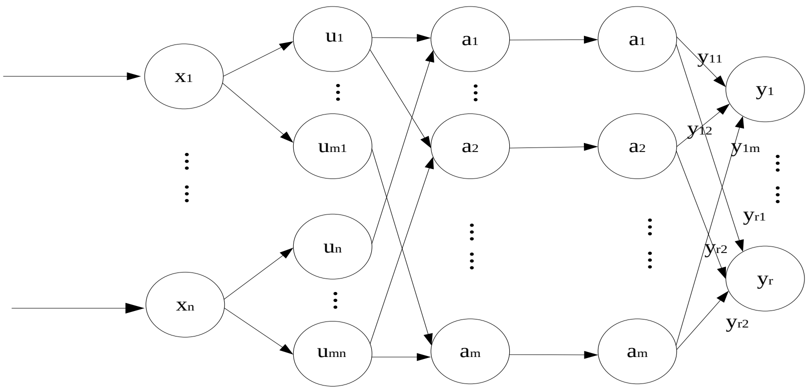

Figure 3: Simplified diagram of T-S network

For the learning problems of c_{ij} and σ_{ij}, the simplified structure is similar to that of the Mamdani-type neural network, that is, y_{ij} $=w_{ij}$, which can fully rely on the previous results, namely

$$\sigma_i^{(5)} = t_i - y_i \quad (i=1,2,\ldots,n) \tag{16}$$

$$\sigma_i^{(4)} = \sum_{i=1}^{r} \sigma_i^{(5)} y_{ij} \quad (j=1,2,...,m) \tag{17}$$

$$\sigma_i^{(3)} = \sigma_i^{(4)} \sum_{\substack{i=1 \\ i \neq j}}^{m} \alpha_i / (\sum_{i=1}^{m} \alpha_i)^2 \quad (j=1,2,...,m) \tag{18}$$

$$\sigma_{ij}^{(2)} = \sum_{k=1}^{m} \sigma_i^{(3)} s_{ij} e^{-\frac{(x_i - c_{ij})^2}{\sigma_{ij}^2}} \quad (i=1,2,...,n;\ j=1,2,...,m) \tag{19}$$

Finally got:

$$\frac{\partial E}{\partial c_{ij}} = -\sigma_{ij}^{(2)} \frac{2(x_i - c_{ij})}{\sigma_{ij}};\ \frac{\partial E}{\partial \sigma_{ij}} = -\sigma_{ij}^{(2)} \frac{2(x_i - c_{ij})^2}{\sigma_{ij}^{(3)}}$$

$$c_{ij}(k+1) = c_{ij}(k) - \beta \frac{\partial E}{\partial \sigma_{ij}};\ \sigma_{ij}(k+1) = \sigma_{ij}(k) - \beta \frac{\partial E}{\partial \sigma_{ij}} \tag{20}$$

In the formula, $\beta>0$ is the learning rate, i=1,2,...,n; j=1,2,...,m.

4. Experimental Results and Analysis

This paper evaluates the performance of the semantic matching system oriented to the Semantic Internet of Things. The improved S-Match algorithm compares the difference in algorithm efficiency between the improved S-Match algorithm and the traditional S-Match algorithm under the same hardware environment; computability the logic CL4 is carried out from two aspects. On the one hand, the precision of the test data is used for evaluation, and the comparison between the existing algorithm and the algorithm proposed in this paper is obtained under the same environment; on the other hand, the recall index of the test data is used for evaluation. The comparison between the existing algorithm and the algorithm in this paper is obtained under the same environment.

4.1 Construction of the IoT English Platform

(1) System Architecture Design

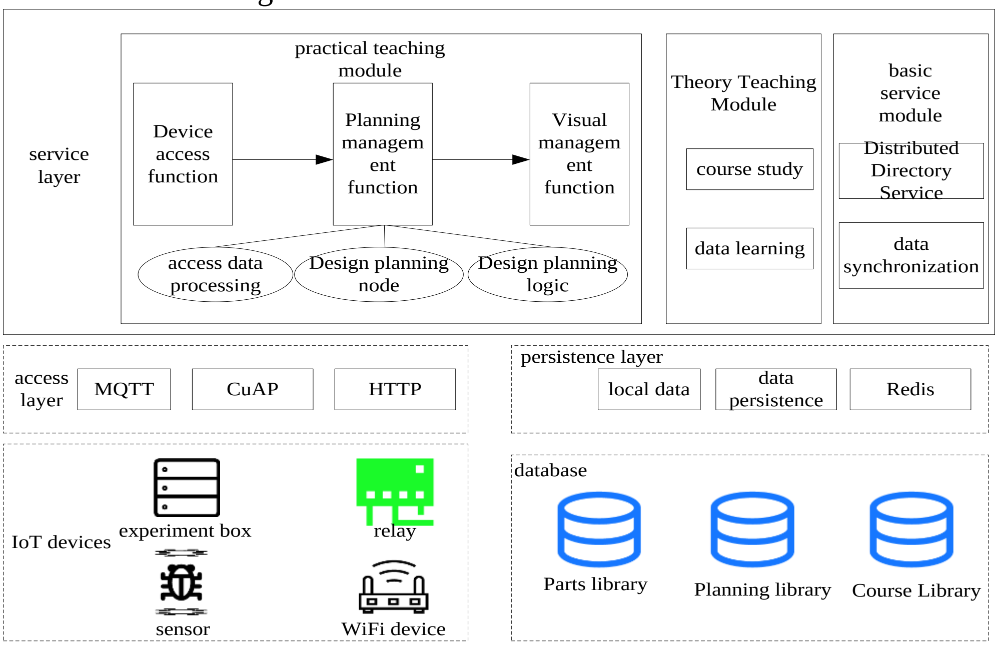

Figure 4: Architecture design of the IoT English platform

Limited by technical conditions and research and development time, traditional teaching platforms are often monolithic. There are many problems in the development process of a project based on a monolithic architecture. Every R&D, update, and deployment in the development process will affect the entire system. Once a problem occurs, the entire system will collapse. The distributed architecture-based system has unparalleled advantages in fault tolerance, continuous delivery capability, R&D efficiency and scalability. It takes into account that the IoT English Platform has high requirements for scalability and fault tolerance, and the R&D personnel have a certain skill base. Therefore, it chooses a distributed architecture to complete the system design, and ensures high cohesion and low coupling of functional modules under the premise of normal realization of system business functions. It has high processing efficiency and fault tolerance at the same time. The architecture design of the IoT English Platform is shown in Figure 4.

As shown in FIG. 4, the specific flow of the system processing the user request is as follows. When the user interacts on the platform through the UI, an HTTP request is issued, and the service gateway performs the first round of request processing, and rejects the user request without permission. It then forwards the request to the logical processing module based on the current server state and cluster task conditions. The logic processing module performs automatic processing according to the business function requirements, and returns the interaction results to the user after completing the calculation. It stores the data and files that need to be stored into the system through the interface.

(2) Division of system modules

According to the design principles of low coupling and high aggregation of module division, the module division of the system is shown in Figure 5.

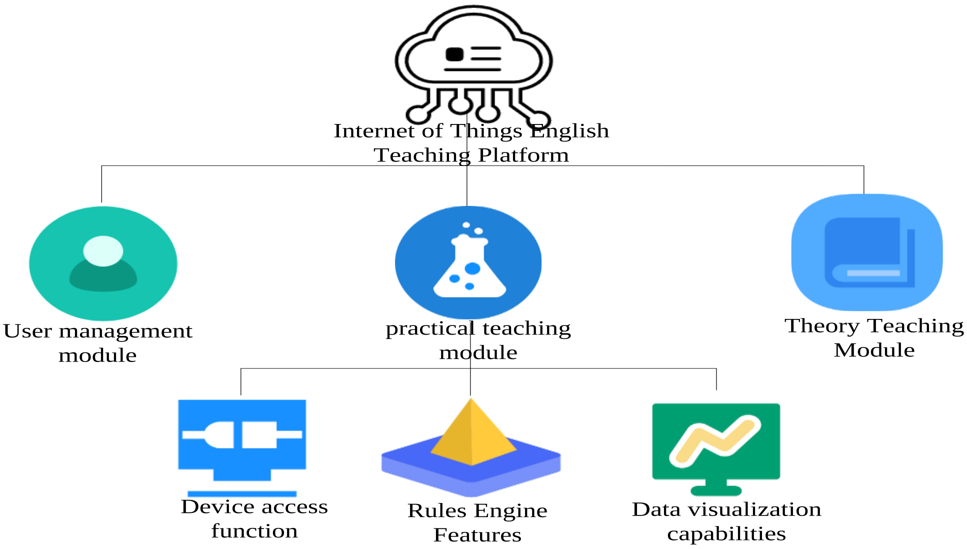

Figure 5: Module division of IoT English Platform

As shown in Figure 5, the functional modules of the IoT English Platform are designed as three independent service modules. They are user management module, theoretical teaching module, and practical teaching module (including device access function, rule engine function, and data visualization function).

4.2 Comparison of Recall and Precision

Under the same environment, the traditional semantic matching and the system designed by the semantic matching algorithm of this paper are made the same request, and the result is analyzed.

During the experiment, the relevant requests of the corresponding user query were randomly selected to test the computability logic CL4. In the case of the same recall (RP value), the performance of the precision rate (E value), the experimental results are shown in Table 1 shown.

Table 1: Comparison of RP value and E value

System name	Matching method	RP/%	E/%
Traditional semantic matching	Similarity comparison	50	56.7
Computability logic	Logical formula deduction	50	72.9

The experimental results are represented by a line graph, as shown in Figure 6.

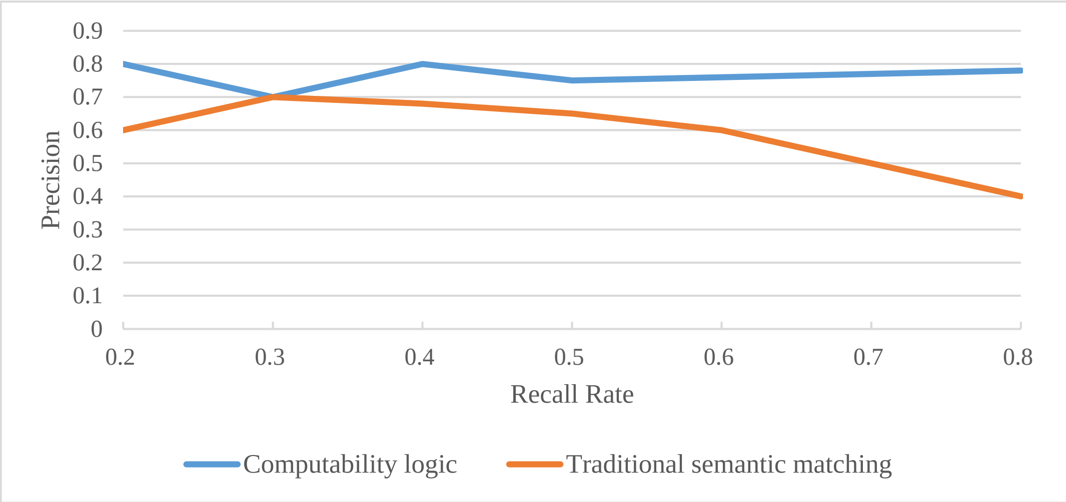

Figure 6: Comparison of recall and precision of matching results

As can be seen from Figure 6, the service quality and execution efficiency of a composite service will be affected by its composite structure and the number of atomic services. From an empirical point of view, the following rules should be followed:

(1) If the combined service is a sequential structure or a parallel structure, the fewer atomic services, the better the service quality;

(2) If the combined service is a cyclic structure, the number of cycles should be minimized, and because the cyclic structure is easy to fall into a state of no solution, if there are other combinations, other combinations are preferred;

(3) The combined service can be regarded as a sequential execution sequence with complex internal structure. Generally, the longer the sequence length is, the worse the service quality of the combined service is.

Based on the above rules, the QoS-based dynamic service composition algorithm involves the following three key issues:

(1) In the dynamic service composition process, the algorithm is the input/output of each service and service involved in the composition process, which can be referred to as data here, and sets the corresponding variable, which is used to record the data from the dynamic service composition. Start up to the optimal QoS value for where the service or data resides, and as the service composition process progresses, it can be reallocated and updated. The input/output data of the services involved in the dynamic service composition process are marked by the concepts in the relevant domain ontology, that is, each data can be mapped to a certain concept in the corresponding domain ontology;

(2) If the input data of a service matches the output data of another service, the two services can be connected;

(3) In general, it can be considered that if a certain data is satisfied, it means that at least one output data matches it. Similarly, if a certain service is satisfied, it means that all its input data are satisfied.

The QoS-based dynamic service composition algorithm uses the combination of the depth-first algorithm and the breadth-first algorithm to find the optimal solution. In the process of dynamic service composition, the optimal QoS calculation of services and data adopts the depth-first algorithm. When all output data are is satisfied, but the service combination result is not unique, the breadth-first algorithm is used to obtain the optimal solution [16].

4.3 Response Time Comparison

Using the experimental data in Table 2 to conduct experiments, the results show that the improved S-Match algorithm designed in this paper has shorter time consumption and faster response speed than the traditional S-Match algorithm in algorithm efficiency. The experimental results are represented by a line graph, as shown in Figure 7.

Table 2: Response time comparison

System Name	Matching Method	Deduction Of The Number Of Nodes	Time (Milliseconds)
Match	Logical Formula Deduction	175	685
Improve s-Match	Logical Formula Deduction	175	550

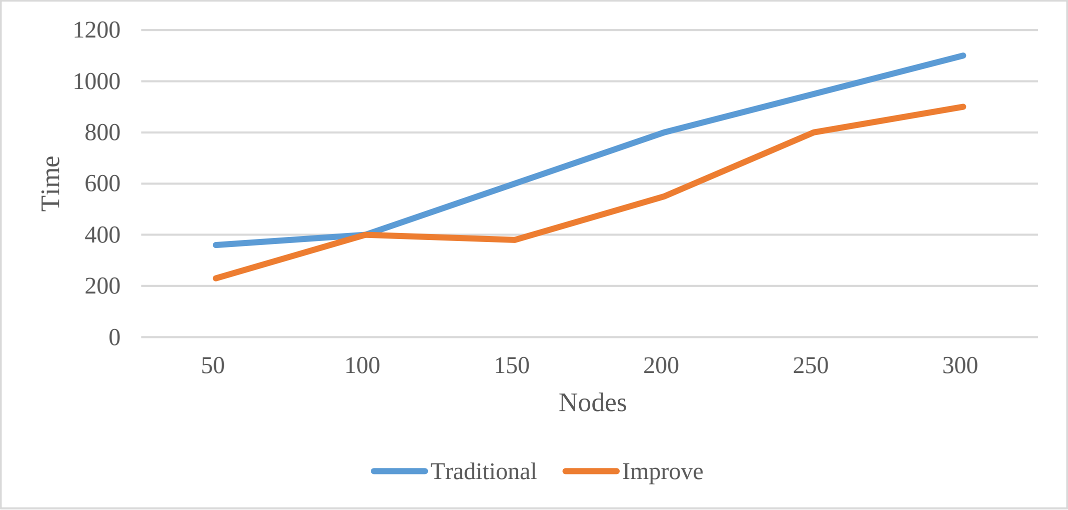

Figure 7: Number of services and response time curve

The experimental results of the improved S-Match algorithm and the computability logic CL4 show that the improved S-Match algorithm improves the query efficiency under the same environment, and the computability logic CL4, on the basis of the same recall rate, greatly improved the precision rate.

5. Conclusions

With the advancement of technology and the rapid development of artificial intelligence, there are more and more semantic matching scenarios, and users' demand for semantic matching is also increasing. At the same time, the real world is in an open, dynamic, and linked environment. Static knowledge can no longer meet the demand, so the ability to express dynamic knowledge in the real world is more and more important, and it is also an important part of the field of artificial intelligence.

In order to solve the problem of semantic collaboration in the Semantic Internet of Things (SWoT) environment, this paper proposes an ontology matching algorithm based on logical formula deduction. Combined with the systematic analysis of the specific application of semantic collaboration in SWoT, the ontology matching algorithm is designed and related systems are implemented. Relevant experimental results have shown that the algorithm designed in this paper has more advantages in solving more refined problems and facilitating human-computer interaction, while also ensuring that it is always pushable in the open world.

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