Intelligent Customer Service System Design Based on Natural Language Processing

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Abstract: With the competition between the small and micro enterprises in the domestic market becoming increasingly fierce, many enterprises have considered reducing the internal operating costs and improving staff efficiency as well as external customer satisfaction to establish the company's own brand image gradually. On this occasion, building a company's own intelligent customer service system has gradually been taken seriously by many small businesses. However, the construction and maintenance costs of large-scale call center systems are not affordable for small enterprises. Therefore, developing a low-cost, small-capacity and easy-to-maintain voice system is crucial for the future development of small and micro enterprises. Based on this background, the machine learning and natural language processing techniques are used to implement the transformation of the customer service system from template-based responses to intelligent learning in this study. To explain the principles and analyze the advantages and disadvantages of the existing service systems, the common customer service systems on the market are summarized and classified firstly, which are used to summarize the requirements and outline the framework of the object design. On this basis, the "Turing Robot" platform is used to build an intelligent customer service system environment, of which test results shows that based on machine learning and semantic analysis, the intelligent customer service system tailored for small enterprises can provide accurate answers and intelligent services for customers all day.

1. Introduction

In the mobile Internet era, the information is more transparent and easier to be acquired, while the limitations of the traditional artificial voice customer service in terms of “acquisition of information and timeliness of service response” have become increasingly prominent. On the one hand, with the continuous increase in the number of mobile communication users and the increasing number of IOT (Internet of Things)-based activities, users’ service support requirements for business consulting and after-sales service complaints are not limited to traditional 10086 and business consulting. As a result, the increase in labor costs and the increase in the mobility of traditional customer service personnel have made it impossible for existing manual services to “respond quickly” to various marketing and service support needs of various types of users [1]. On the other hand, the rapid development of the mobile internet and the behavioral patterns of customer accessing to service support and marketing information have also undergone dramatic changes [2]. In particular, the younger groups are more interested in instant and interactive access to services. Therefore, how to comply with the changes of the Internet age, cater to customer behavior patterns, and meet the needs of a wide range of user groups for convenient access to service support and marketing information at any time has become an important issues for current customer service systems [3].

The traditional customer service models can be divided into the following three groups: (1) one-to-one voice services for seats; (2) order systems for multiple intersections; (3) mailbox message. The resolution of traditional customer service models have obviously not been able to adapt to the fast-growing business demands [4]. Therefore, we urgently need a new solution to improve customer service response efficiency and customer satisfaction in order to actively respond to customer service model transformation, and the subject of this paper is set to "a new generation of

intelligent customer service system research."

At present, how to make computers understand human natural language and use human natural language to simulate language communication process to realize "man-machine dialogue" have become an important research field of artificial intelligence-natural language processing. Once the computer system realizes human-machine dialogue, machine translation, automatic summarization, or language information processing functions such as being able to fluently read articles and read emotions, the boring atmosphere of the computer screen will inevitably greatly change, and the application environment of computers will become more fascinating [5s].

The question answering system design has been a hot research topic integrating natural language processing, knowledge representation, and information retrieval, which is based on text retrieval but different from traditional search engines. The traditional search engine requires the user to input some combination of keywords, and the user submits the query only locate the literature, the user must rely on themselves to filter the required useful information; and the question answering system allows the user to enter a question in the form of natural language [6]. Finally, the short and accurate answer in natural language form is returned to the user.

At present, many foreign scientific research institutions have participated in the research of the English question answering system, and there are even relatively mature English question answering systems [7]. However, there is not much research on participating in the Chinese question answering system because the Chinese question answering system requires higher research in related fields. For example, there are no spaces between Chinese words; syntactic analysis and semantic understanding of Chinese are more difficult, which has caused slow development of Chinese question answering systems. As a result, the study about the intelligent customer service system based on natural language processing technology to achieve the Chinese question answering is of great significance.

2. Common Intelligent Customer Service System Analysis

In China, telecom operators headed by China Mobile and China Telecom have earlier established a voice call-based customer service system that mainly deals with customer tariff inquiries, business handling, and complaint proposals. In the small enterprise industry, with the rapid increase in the number of small enterprise departments, how to get rid of the traditional manpower management and use advanced methods to create a more feature-rich, better-experienced customer service system is an urgent problem to be solved.

Tab.1 Common Customer Service System Classification and Brief Features

Customer service system classification		Interactive mode	Communication Method	Communication efficiency	Communication Quality	Application Scenario
Manual service	Telephony	Man to Man	Single to single, Voice	Low	Relevant to customer service staff knowledge reserve, business literacy, busyness, etc.	Telecom operators
	IM (instant messaging)		One to many, voice, text, picture	Medium		SME website
	Online customer service		One to many, text, picture			Shopping site
Computer Service	Keywords: q&a□	MAC Man And Computer	One to many, text, picture	High	Related to user questioning methods and knowledge base reserve	Government affairs, finance, etc.
	Intelligent Question-Answer System				Leverage natural language processing and Semantic Web technology to provide simple, accurate responses	Medical, education and other subdivisions

From the perspective of expression form, the common customer service systems are mainly

divided into two categories: artificial customer service and computer customer service, and each category has different characteristics as shown in Table 1. In general, the former is based on interaction between people, and the latter is based on the interaction between people and machines.

3. Structure Design of Intelligent Customer Service System

In general, the formal words are a combination of stable words, and therefore the more times that adjacent words appear at the same time, the more likely it is to form a word in context. Therefore, the frequency or probability of co-occurrence of words and words can better reflect the credibility of words. A statistically-based approach to understand sentence is to select the most likely sentence from all candidate words in each position of a sentence. It is assumed that a word is only related to the preceding N-1 words, and if there is no N-1 tone to make up with empty tone, the N1-order Markov model will also particularly referred to as an N-gram model in speech understanding.

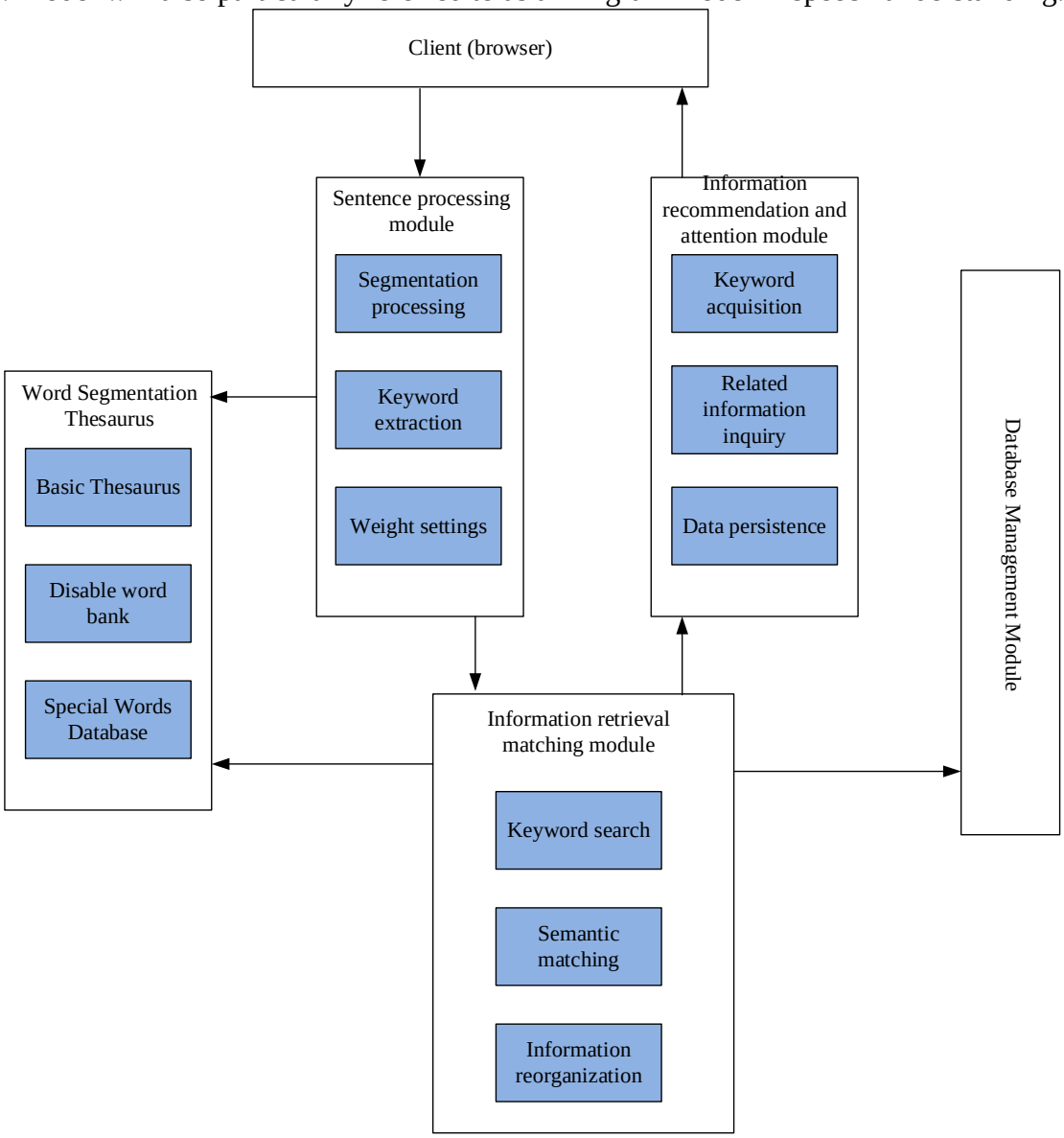

Fig.1 Intelligent Customer Service System Structure

Mutual information reflects the closeness of the relationship between Chinese characters. When the degree of closeness is higher than a certain threshold, it can be considered that this block may constitute a word. This method only needs to count the frequency of word groups in corpus and does not need to divide the dictionary. Therefore, it is also called no dictionary word segmentation method or statistical word acquisition method. However, this method also has certain limitations. For example, it often extracts frequently used words that have high frequency but are not words,

such as "this", "one", "some", "my" and so on, and the recognition accuracy of common words is poor while the space-time overhead is large. The practical application of the statistical word segmentation system uses a basic word segmentation dictionary (common word dictionary) to perform string matching and word segmentation. At the same time, statistical methods are used to identify some new words, that is, to combine string frequency statistics and string matching, and to use not only matching word segmentation but also the characteristics of fast speed and high efficiency. In addition, it also makes use of the advantages of no dictionary segmentation combined with context recognition of new words and automatic elimination of ambiguities [8]. Based on the aforementioned consideration, the intelligent customer service system structure provided by this study is shown in Figure 1.

3.1 Knowledge Base Based on Natural Language Processing

The mobile informatization knowledge base includes mobile business models, data models, etc., which has a large amount of business data. When a salesperson recommends related services to customers, it is necessary to train these knowledge and keep in mind relevant requirements. Due to the large amount of data, it is impossible to store all knowledge information in the human brain, which needs to be symbolized and formalized. Through this data structure, various knowledge in the field of mobile services can be incorporated into the computer system's programming process. The data structure approach can be used to summarize knowledge so that salespersons can quickly search mobile business knowledge, and the mobile business data knowledge can be analyzed to build mobile business knowledge base through semantic, contextual relevance, analysis, and integration.

The natural language processing intelligent customer service system is designed to accept the user's question in the form of natural language description, and to find an information retrieval system that can answer the question accurately and concisely from the mobile knowledge base platform. That is, in the intelligent customer service system, the user issues relevant to business consulting and bill inquiry are presented on the interactive interface. The intelligent customer service system can search the mobile knowledge base for a corresponding interpretation caliber, integrate the knowledge through an algorithm and push the answer to the user. On the page, the user can continue to ask questions based on the answer or click on the business management link to directly handle

3.2 Model design of natural language processing

The natural language processing model used in the presented intelligent customer service system is shown in Figure 2, which is mainly composed of two relatively independent parts: the knowledge base part and the online consultation processing part. It is noted that the management part of the knowledge base is mainly to build a mobile knowledge base, of which purpose is to collect the mobile service knowledge base, such as marketing briefs, product information, descriptions of various types of package conflicts, billing priorities, and the establishment of such knowledge information. By processing the original information, a semantic index library with mobile knowledge base information is finally obtained. The online consulting part is designed to implement the following functions: obtaining the user's query content, requesting the query condition code, analyzing the word segmentation through the user's input content, performing the engine query semantic query index database according to the keyword, performing the most algorithmic sorting on the search result set. Finally, the obtained excellent result will return to users through the interface.

In this study, two indicators of recall rate and precision rate are introduced to analyze the designed customer service system. The precision rate is used to measure the signal-to-noise ratio of a retrieval system, that is, the percentage of detected relevant documents and the total number of detected documents. The recall rate is used to measure the success of a certain search system in detecting relevant documents from a collection of documents, that is, the percentage of detected relevant documents and the total number of detected documents in the search system. It is noted that the use of more generalized search language (such as top-level and top-level keywords) can increase

the recall rate, but the precision rate will decrease accordingly.

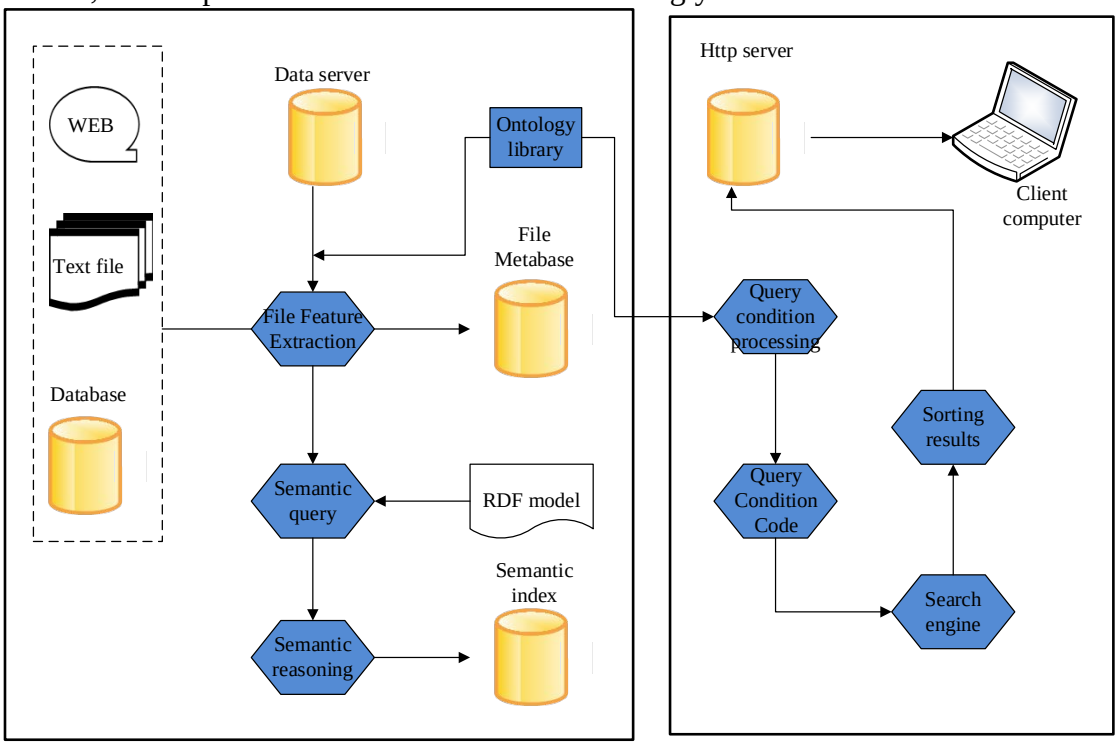

Fig.2 Natural Language Processing Model

4. Conclusion

As a reinforcement of traditional artificial voice customer services, the intelligent customer service system is an essential service model in the era of mobile Internet. For mobile operators whose business development is constantly updated, the intelligent customer service not only can satisfy requirements of the era of mobile Internet that users can obtain the psychological expectation of service support anytime, but also can realize the fast, accurate and precise delivery of marketing information to enterprises, so as to achieve the purpose of reducing the cost and increasing the benefits. Based on this research background, this paper firstly analyzes the advantages and disadvantages of the traditional question & answering customer service system from three modules: problem handling, information retrieval, and answer extraction. Then, the process flow of the intelligent customer service system based on the natural processing model is provided: when user asks a question to the system, the user's questions are processed to determine the question type firstly, and then the conditions that answers need to meet are analyzed; finally, the keywords and extension sentences will be returned to users by the question processing module. In addition the information retrieval module is designed to find document paragraphs related to these keyword strings in the index structure, and calculate the weights of related paragraphs to sort them in order, which will be sent to the answer extraction module according to the weights. As a public service place with strong specialty, vertical branch, and high population density, the small enterprises can introduce the unattended intelligent customer service system to save the workload of the artificial customer service, and meet the business needs to improve the customer experience.

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