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ONLINE CUSTOMER SERVICE SYSTEM USING HYBIRD MODEL

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ABSTRACT

In a traditional customer service support environment, service engineers typically provide a worldwide customer base support through the use of telephone calls. Such a mode of support is inefficient, ineffective and generally results in high costs, long service cycles, and poor quality of service. The rapid growth of the World Wide Web and Intelligent Agent technology, with its widespread acceptance and accessibility, have resulted in the emergence of Web-based and AI Agent-based systems. Depending on the functionality provided by such systems, most of the associated disadvantages of the traditional customer service support environment can be eliminated. This paper describes a framework for Web-based and AI Agent-based online customer service support system, and discusses the method to use Rough Set Theory and Neural Network Theory to support intelligent fault diagnosis by customers or service engineers.

***Keywords*: ** Customer support service; IA for online; Rough set; Neural network

1. INTRODUCTION

In electronic commerce age, dealers not only make advertisement, marketing, payment and so on but also make after service such as resolving difficult problems on Internet, which provide many convenience to customers. IA for online customer support system is that some computer or software companies establish customer service center on Internet in order to perfect after service and guarantee that customers use product in gear. Currently online customer support systems in common use are frequent question solution systems which are based on BBS, and these systems actually classify and gather some problems maintenance engineers often meet with so that customers can access these data at any moment to solve their problems. Online customer support systems based on BBS improve more in many aspects such as reducing the service cost, providing day and night service and overcoming the regional confine than traditional customer service systems. But these systems merely can solve these ever appearing matters, can not automatically analyse customer's matters because they lack for intelligence. Besides their exhibition form generally is single character form. Consequently it is required for current online customer support system setting a kind of customer service center based on intelligence which can seek technique support service for customer and automatically solve customer's personal matters.

2. IA FOR ONLINE CUSTOMER SUPPORT SYSTEM

IA for online customer support system is a technique project which apply WWW and IA to completely solve deficiencies of customer technique support system.

What is called IA for online here is a sort of software system possessing a certain intelligence characteristic which can automatically replace people to complete certain intelligent operations. The system is made up of three parts, fault information pick-up, fault diagnosis, and result express.

Customers send technique support request to server by browser (Fig.1). According to keyword list or synonyms of keyword list, fault information pick-up subsystem picks up fault expression keywords from text request information customers submit, then combine these keywords into input vector, finally input this vector to fault diagnosis subsystem. Fault diagnosis subsystem selects corresponding repository according to input vector to make fault diagnosis. The result of diagnosis is reflected to customer by result express subsystem. Fault diagnosis is the core of the system in three parts. This paper adopt rough set theory to pick up history fault diagnosis experience, and use neural network theory to

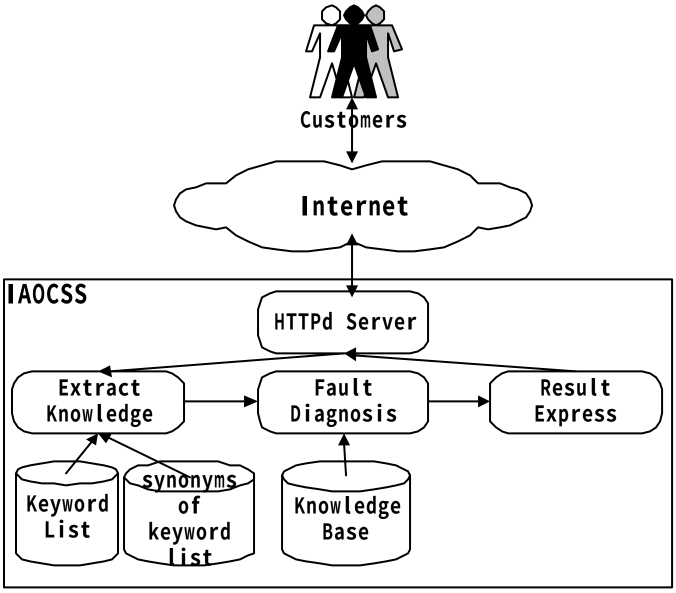

Fig 1: System Structure
For Intelligence Online Customers Service

implement intelligence fault diagnosis method of reasoning process.

3. ROUGH SET THEORY

Pawlak (1982) first introduced rough set theory. The philosophy of the method is based on the assumption that with every object some information (data, knowledge) can be associated, and knowledge being in the data is emerged according to debasing the precision of the data. Accordingly it takes on favourable effects to detect knowledge from imprecise information such as history fault diagnosis experience applying rough set theory. How to apply rough set theory to making fault diagnosis is showed as below.

3.1 Information System and Indiscernibility Relation

By rough set theory a fault case is regarded as an information system S,S can be expressed by

$$S = (U, Q, V, \rho)$$

where U is a finite set of fault matters, Q is a finite set of attributes incurring fault, $V = \bigcup_{q \in Q} V_q$ and V_q is a domain of the attribute q, and $\rho : U \times Q \rightarrow V$ is a total function such that $\rho(x,q) \in V_q$ for every $q \in Q$, $x \in U$; called an information function.

Let $P \subseteq Q$ and $x, y \in U$, we say that x and y are indiscernible by the set of attributes P in S if $\rho(x,q) = \rho(y,q)$ for every $q \in P$. Thus every $P \subseteq Q$ generates a binary relation on U which will be called an indiscernibility relation, denoted by $IND(P)$.

Equivalence classes of $IND(P)$ are called P-elementary sets in S. The family of all equivalence classes of relation $IND(P)$ on U is denoted by $U|IND(P)$ or, in short, $U|P$.

$Des_p(X)$ denotes a description of P-elementary set $X \in U|P$ in terms of values of attributes from P, i.e.

$$Des_p(X) = \{(q,v) : \rho(x,q) = v, \forall x \in X, \forall q \in P\}$$

3.2 Approximation Of Sets

Let $P \subseteq Q$ and $Y \subseteq U$. The P-lower approximation of Y, denoted by PY , and the P-upper approximation of Y, denoted by $\overline{P}Y$, are defined as:

$$PY = \bigcup \{X \in U|P : X \subseteq Y\}$$

$$\overline{P}Y = \bigcup \{X \in U|P : X \cap Y \neq \phi\}$$

The P-boundary (doubtful region) of set Y is defined as

$$Bn_p(Y) = \overline{P}Y - PY$$

With every set $Y \subseteq U$; we can associate an accuracy of approximation of set Y and P in S, or in short, accuracy of Y, defined as:

$$\alpha_p(Y) = \frac{card(PY)}{card(\overline{P}Y)}$$

3.3 Approximation of a partition of U

Let S be an information system, $P \subseteq Q$; and let

$y=\{Y_1,Y_2,...,Y_n\}$ be a partition of U. The origin of this partition is independent on attributes from P. By P-lower and P-upper approximation of C in S, we mean sets $\underline{P}y=\{\underline{P}Y_1,\underline{P}Y_2,...,\underline{P}Y_n\}$ and $\overline{P}y=\{\overline{P}Y_1,\overline{P}Y_2,...,\overline{P}Y_n\}$ respectively. The coefficient

$$g_p(y)=\frac{\sum_{i=1}^{n}card(\underline{P}Y)_i}{card(U)}$$

is called the quality of approximation of partition by y set of attributes P, or in short, quality of sorting.

3.4 Reduction of attributes

Discovering dependencies between all fault attributes and detecting main attributes is of primary importance in intelligence fault diagnosis. According to rough set theory, if subset $R\subseteq P\subseteq Q$ such that $g_P(y)=g_R(y)$ Is called y -reduct of P (or, simply, reduct if there is no ambiguity in the understanding of y) and denoted by $CORE_y(P)$. Note that an information system may have more than one y -reduct. Intersection of all y -reducts is called the y -core of P, i.e. $CORE_y(P)=\bigcap RED_y(P)$. The core $CORE_y(P)$ is a collection of the most significant fault attributes in the system.

3.5 Fault Classification Rules

If $Q=C\bigcap D$ and $C\bigcap D=f$, where C are called the set of fault attributes, and D, the set of fault types. $S=\langle U,C\bigcup D,V,r\rangle$ is called decision table otherwise it is non-deterministic. Decision table will be used in fault diagnosis.

If let $Des_p(X)=\{(q,v):r(x,q),\forall x\in X,\forall q\in P\}$, X_i (i=1, ...,k, where k is the number of $U\,|\,IND(C)$), and Y_j (j=1, ...,n, where n is the number of $U\,|\,IND(D)$), $Des_C(X_i)\Rightarrow Des_D(Y_j)$ is called the (C, D) -decision rule. Thereby, applying rough sets can describe the corresponding relation between the set of fault attributes C and the set of fault types D, which is confirm fault classification rules.

3.6 Fault Diagnosis

After fault classification rules are confirmed, it will appear three situations for any fault attribute *C:*

fault attribute *C* matches one decision rule, namely corresponds to fault types *D;*

fault attribute *C* matches more than one decision rules, but its decision result is same;

fault attribute *C* does not match any decision rule.

Fault diagnosis result can directly de derived for situations a) and b). For c) expert is needed for deriving the result. Consequently, applying rough set theory can pick up fault attributes reduction sets of all types of fault classifications, and form the fault diagnosis decision rules. But the diagnosis result is derived by people's concerning, which can not content intelligence diagnosis.

4 NEURAL NETWORK

Neural network technology is one of theory and method which was developed in an attempt to mimic the acquisition of knowledge and organization. The using of neural network technology in model recognition and precision domain is more and more regarded, because a trained neural network can achieves a high degree of prediction accuracy according to input data.

Many individual computational units that make up neural network are referred to as nodes , or processing elements (PEs). Fig.2 shows general PE model. The PE has many inputs , but has only a single output, which can fan out to many other PEs in the network. The input the *i*th PE

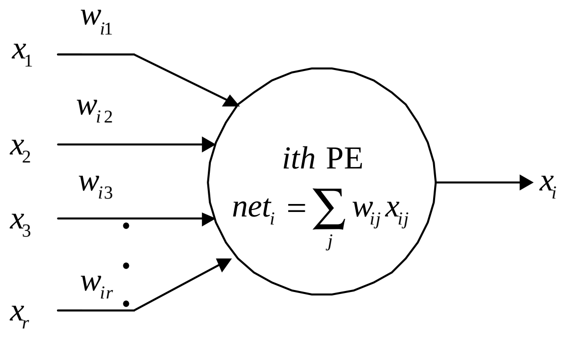

Fig.2.General symbol of PE(Processing Element)

receives from the *j*th PE is indicated as x_j. Each connection to the *i*th PE has associated with it a quantity called a weight. The weight on the connection from the jth node to the ith node is denoted w_{ij}. Each PE determines a net-input value $net_i = \sum_j w_{ij} x_j$ based on all its input connections. Once the net input is calculated, it is converted to an activation value, by activation function, $x_i = f_i(net_i)$. Fig.3 describes general neural network configuration having a hidden layer. The set of PEs which run simultaneously, or in parallel, is called a layer and there are input layer, output layer, and hidden layer(s).

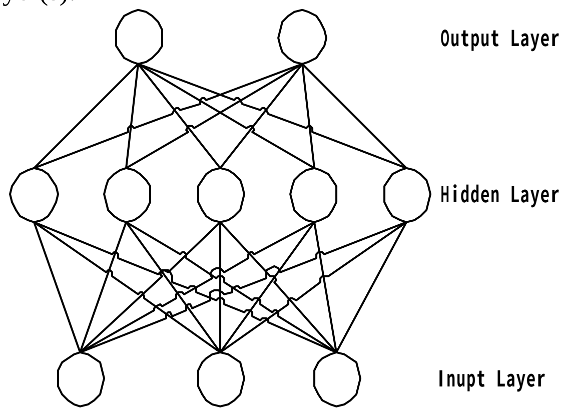

Fig.3. Multi-layered neural network

The high degree of prediction accuracy of neural network is based on its right model and low noise training data. In practice it is very difficult to tick out the noise data from lots of training data, and so is the same time the minimized factor set. All these retard the applying of neural network.

In this paper, we propose a method in which data is preprocessed and the rules is developed by using rough sets theory first, and then the failures that does not match any of the rules are diagnosed by using neural network technology. This method can increase the accuracy of the fault diagnose, make the diagnosis processing auto going and support the intelligence online fault diagnose.

5. THE HYBIRD MODELS OF FAILURES INTELLIGENCE DIAGNOSE

The hybird models of failures intelligence diagnose is realized by two phrases. In the first phrase, acquisition knowledge processing and neural network training are fulfilled, Fig.5. In this phrase factors and objects can be reduce to history failures and rules can developed by using rough set theory. Then data without noise and model that has been adopt are input into system to train the neural network and propriety model are built.

The second phrase is failures intelligence diagnose, it can diagnose the failures intelligent according to the failures

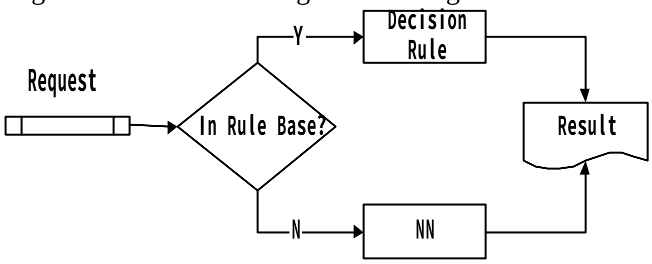

Fig4 The First Stage Model

phenomena based on the decision rules and neural network model that has been built in the first phrase, Fig.5.

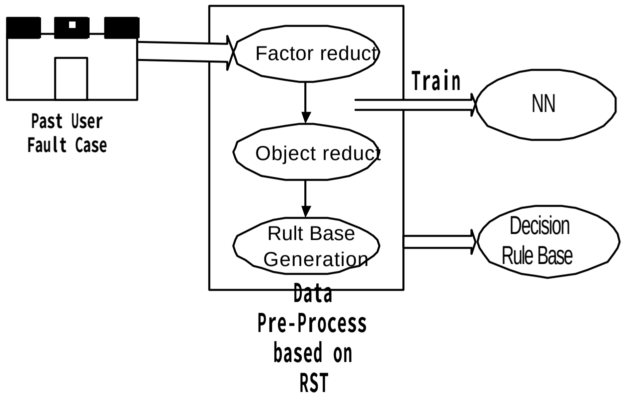

Fig.5. The Second Stage Model

6. CONCLUSIONS

The intelligent online customer service can provide availability and smart online service to the customer. Especially in the EC period, it is important in integrating online service each other. The application of online intelligent customer service is still in the exploring period because it involve in WWW technology, AI technology and management theory, especially intelligent fault diagnose and customer information analysis is a studying focus.

Reference

1. Pawlak, Z. Rough Set International, Journal of Information and Computer Science, 11 1982

2. Slowinski, R Rough Classification with valued closeness relation, E. Diday 1994

3. Trippi, R., & Turban, E. The impact of parallel and neural computing on managerial decision making. *Journal of Management Information Syste*m, 1989

4. K. Balakrishnan, V. Honavar, Intelligent diagnosis systems,Journal of Intelligent Systems, 1998

5. B. Lees, J. Corchado, Case based reasoning in a hybrid

agent-oriented system, in: Proceedings of 5th German Workshop on Case-Based Reasoning, 1997
6. Z.Q. Liu, F. Yan, Fuzzy neural network in case-based diagnostic system, IEEE Transactions on Fuzzy Systems, 1997