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An Intelligent Interface Integrated Services Environment for Electronic Commerce

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Abstract

This paper proposes an intelligent interface integrated services environment for electronic commerce. It contains four main modules, i.e., dialog manager, EC transaction ontology, information collector, and data analyzer. The dialog manager manages the transaction history of the user to collect the user-specific information. It also provides different helping functions for the user. The EC transaction ontology stores the business type of electronic commerce in the system. It classifies the business process into eight categories, i.e., transaction type, ordering pattern, merchandise type, logistic type, customer category, transport vehicle, delivery type, and service type. It also provides the relations and constraints between different business steps. The information collector instantiates and dispatches different information agents to extract, filter, and synthesize relevant transaction data from different data sources timely. The data analyzer is the main component of the system. It instructs the dialog manager to provide proper helping functions for the different users. It then uses the user model to classify the knowledge and skill level of a user. It also predicts the goal of the user by using case-based reasoning and fuzzy Petri-Net to recommend the user with the best transaction plan and browsing behavior. Finally, it monitors the quality of service that the system provided for the user. This environment not only provides an integrated human-machine interface but also manages the business information thoroughly for the users.

1. Introduction

The pervasive connectivity of the Internet provides the best mediation for a company to reduce the cost of products and establish closer relationship with customers. These companies usually incorporate the selling and marketing policy to provide interactive, friendly, and reliable services for the user. Electronic commerce (EC) should become the critical successful factor to compete with others in the modern network marketing [1][3][6][13][15]. The supply chain management (SCM) and customer relationship management (CRM) play important roles in EC. The SCM provides the efficient management method to deliver products from the supplier to the customer quickly. It incorporates the supply chain resources including ordering, logistics, manufacture, and distribution to response any change of the market timely. The CRM provides an interactive, kind, and customer-made service to understand and serve their users. It incorporates the personalized service for different users to achieve the most loyalty and the maximum benefits for the company perfectly.

Many industries complete business transactions through the traditional or semi-automatic procedures, i.e., electronic data interchange, to buy or sell goods. They usually use some traditional or special communication equipments to exchange transaction information. These data exchange process may cause some limitations. First, the data contained in the business process may not be able to combine into an information chunk completely. It may cause some process delay or mistake, e.g., ordering and dispatching, if it only works done by hand or separate the whole transaction process into many pieces steps. Second, both the buyer and seller may produce misunderstandings or lose the chance to make competitive advantages if they cannot obtain complete, sufficient, and transparent information just in time. Third, they didn't provide a friendly and customize human-machine interface for the users in the traditional transaction procedure. It may obstruct the transaction process for different kinds of users. Finally, they didn't provide any systematic and suitable assistant and helping for the user with different experiences to complete the business transaction properly.

Many systems have been proposed to solve the above shortcomings. They try to use EC contained in the above to automat the business process. Seldom of them provide an integrated service environment for the users. They don't provide a transparent interface to integrate the data that located in heterogeneous data sources and distributed in many different sites. They also cannot provide an anytime service to present the business information just in time. They usually ignore the privilege of the user to understand and utilize the information in the process of EC. Moreover, many systems only provide a stereotyped interface for the user to yield the system. They don't consider the requirements and the working environment for the user with different experiences and proficiency.

This paper proposes an intelligent interface integrated services environment for electronic commerce. It contains four main modules, i.e., *dialog manager, EC transaction ontology, information collector,* and *data*

analyzer. The *dialog manager* manages the transaction history of the user to collect the user-specific information. It also provides different helping functions for the user to do right actions in the right time. The *EC transaction ontology* stores the business type of EC in the system. It classifies the business process into eight categories, i.e., transaction type, ordering pattern, merchandise type, logistic type, customer category, transport vehicle, delivery type, and service type. It also provides the relations and constraints between different business steps. The *information collector* instantiates and dispatches different information agents to extract, filter, and synthesize relevant transaction data from different data sources timely. The *data analyzer* is the main component of the system. It instructs the dialog manager to provide proper helping functions for the different users. It then uses the user model to classify the skill and knowledge level of a user. It also predicts the goal of the user by using case-based reasoning and fuzzy Petri-Net to recommend the user with the best transaction plan and browsing behavior. Finally, it monitors the quality of service that the system provided for the user. This environment not only provides an integrated human-machine interface but also manages the business information thoroughly for the users.

2. System Architecture

Fig. 1 shows the architecture of intelligent interface integrated services environment for electronic commerce. It contains four main modules, i.e., *dialog manager, EC transaction ontology, information collector,* and *data analyzer*. The *dialog manager* manages the transaction history of the user to collect the user-specific information. It also provides different helping functions for the user to do right actions in the right time. The *EC transaction ontology* stores the business type of EC in the system. It classifies the business process into eight categories, i.e., transaction type, ordering pattern, merchandise type, logistic type, customer category, transport vehicle, delivery type, and service type. It also provides the relations and constraints between different business steps. The *information collector* instantiates and dispatches different information agents to extract, filter, and synthesize relevant transaction data from different data sources timely. The *data analyzer* is the main component of the system. It instructs the dialog manager to provide proper helping functions for the different users. It then uses the user model to classify the skill and knowledge level of a user. It also predicts the goal of the user by using case-based reasoning and fuzzy Petri-Net to recommend the user with the best transaction plan and browsing behavior. Finally, it monitors the quality of service that the system provided for the user.

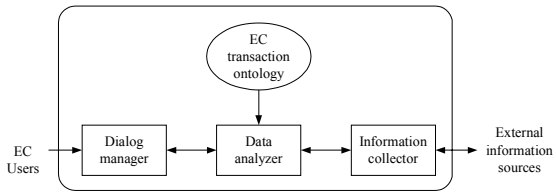

Fig. 1 System architecture

3. Dialog Manager

The dialog manager records the transaction process into the transaction case library. The transaction case library stores the consuming behavior of users into cases. Each case contains the information related to the purchase goal, browsing behavior, merchandise items, and amount of the product. It also provides different dialog modes for the user with different experience and preferences.

4. EC Transaction Ontology

EC transaction ontology stores the information related to the business process [10][11][12]. It classifies the EC transaction into eight categories, i.e., transaction type, ordering pattern, merchandise type, logistic type, customer category, transport vehicle, delivery type, and service type (Fig. 2). The transaction type defines the commerce targets, e.g., B2B, B2C, and C2C. The ordering pattern contains the method to order the product. The merchandise type stores the type of the product, e.g., tangible or intangible item. The tangible item includes raw material, semi-manufactured products, and finished products. The intangible item contains the services for the customer. The logistic type represents the method to manage the products. The customer category contains the classification between the buyer and seller, e.g., supplier, retailer, and personal. The transport vehicle contains the vehicle to deliver the produce, e.g., airplane, train, bus, and motorcycle. The delivery type contains the method to transpose the product, e.g., ordinary mail, express, airmail, and package. The service type defines the service provided for the customers. Note that some of the ontology items borrowed from the ontology structure of CYC [7].

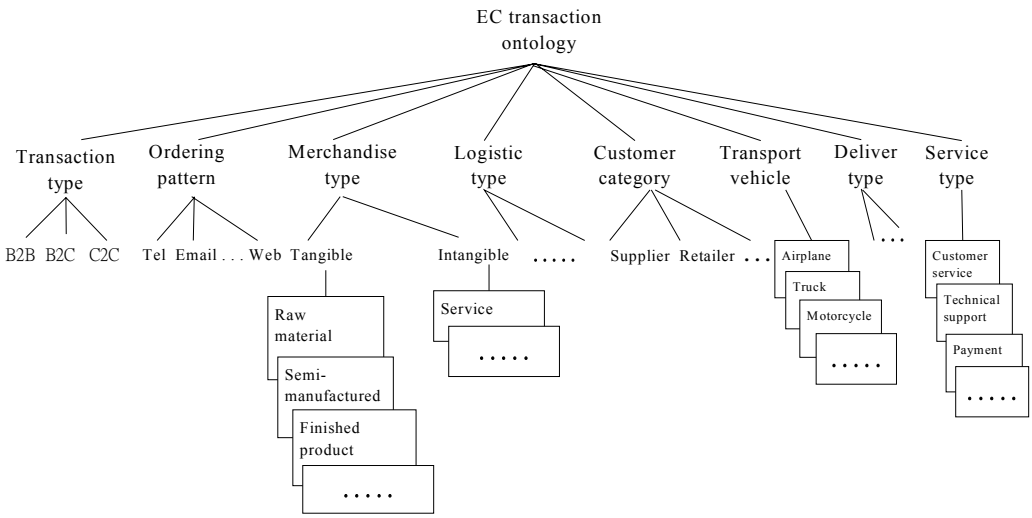

Fig. 2 EC transaction ontology

5. Information Collector

Information collector dispatches different information agents to retrieve related transaction data. The information agent is responsible to retrieve data from different data sources or heterogeneous database. It was generated from the agent pattern library that contains different agent components to do different tasks. The information collector instantiates and composites these patterns to construct different information agents. It retrieves, filters, synthesizes, and sends the most reliable data that the agent collected so far to the data analyzer. Each agent plays the role of *intelligent anytime agent* by recording the retrieved data in the information model. The information model contains the characteristics and the up-to-date data of the information sources. Note that the execution of the pattern library was implemented by Sun's Java remote invocation (RMI) [14]. Fig. 3 shows the pattern of Connect_data_server in the pattern library.

```
Pattern name: Connect_data_server
Pattern task: Data server connection
Receiving: Data server location, database type
Production: Connection status
Context: N/A
Executor:
  import java.rmi.*;
  import java.sql.util.Vector;
  public interface Connect_data_server extends Remote
  { void accept(Agent agent) throws RemoteException;
    Vector Connect() throws RemoteException, SQLException;
    }
  public interface Agent extends jav.io.Serializable
  { void run();
    }
```

Fig. 3 The Connect_data_server pattern

6. Data analyzer

The data analyzer performs four tasks, namely, user modeling, plan prediction, user assistant, and quality of service monitoring. The *user modeling* classifies the user into different skill and knowledge level. The user profile contains the user-related information, e.g., habit, preference, and consumer behavior. The data analyzer uses the above information to classify the users. It preliminarily uses fuzzy ART neural model [2] to classify the users into different groups (Fig. 4). Each group contains the users with same characteristics. It then discriminates the knowledge and skill level of each group of the users. The former evaluates the accuracy, usefulness, direction, and reliability of the user's into five levels, namely, expert, senior, junior, novice, and amateur [8]. The latter measures the correctness, precision, dependency, and effectiveness. The correctness, *U,* measures the correct steps to do business process.

$$U = 1 - \sum_{i=1}^{n} e_i \tag{1}$$

where e_i represents illegal or wrong steps in the business process and $e_i \in [0,1]$. The precision, *P,* represents the average number of operations to complete the business transaction.

$$P = \frac{\sum_{i=1}^{n} t_i}{n} \tag{2}$$

where t_i is the number of operation to complete the ith

transaction and n is number of transaction. The dependency, D, represents the dependency between the business steps.

$$D = \frac{\sum_{i=1}^{n-1} I_i \cap I_{i+1}}{n-1} \quad (3)$$

where I_i is the ith step of the business process and n is the total number of step in the business process. The effectiveness, E, measures the efficiency of the user to complete the transaction.

$$E = \frac{\sum_{1}^{n} w_i}{n} \quad (4)$$

where w_i represents the time to finish the task and n is the number of completed task. The dialog manager may provide different helping functions, interaction modes and graphical user interface for each group of users with different knowledge and skill proficiency correspondingly [8].

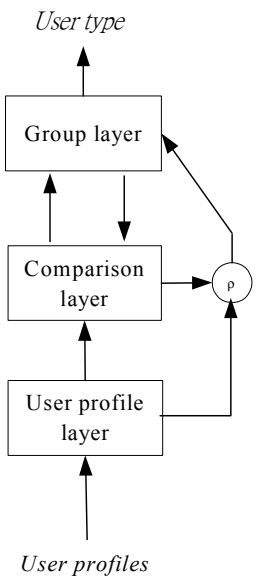

Fig. 4 Fuzzy ART for user classification

The *plan prediction* predicts the transaction plan of the user by using case-based reasoning (CBR) [4][8][9] and fuzzy Petri-Net [5]. The former technique uses the past business history of the user to find the most similar plan. The latter technique uses the similar business plan and the user profile to predict the possible browsing behavior.

The *user assistant* provides a robust assistant for the user to complete the business transaction with the help of EC transaction ontology. First, it checks the completeness and rationality of the transaction data. It then guides the user to input relevant data in the transaction steps. It also recommends the appropriate actions, steps, and browsing behavior for the user to complete the transaction. The *quality of service monitoring* measures the service quality (SQ) of the information sources.

$$SQ=F(A, C, R, T)= A*W_a+ C*W_c+ R*W_r+ T*W_t \quad (5)$$

where A, C, R, and T represent the availability, consistency, reliability, and timeless of the information source, respectively. W_a, W_c, W_r, and W_t are the respective weights. Fig. 5 shows the fuzzy levels of the SQ.

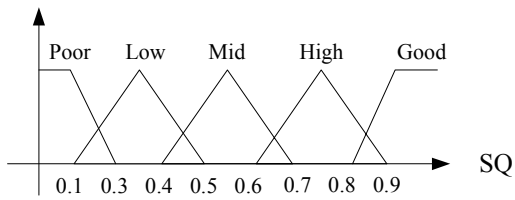

Fig. 5 Fuzzy levels of the service quality

7. Conclusions

We have proposed an intelligent interface integrated services environment for electronic commerce to provide an integrated human-machine interface and business information management. The environment contains four main modules, namely, dialog manager, EC transaction ontology, information collector, and data analyzer. The dialog manager manages the transaction history and supports different styles of interaction patterns and helping functions for the user according to its experiences and knowledge level in business transaction. The EC transaction ontology provides eight categories of business process to assist the data analyzer handling the transaction information. The information collector instantiates and dispatches different anytime information agents to extract, filter, and synthesize relevant transaction data from different data source timely. The data analyzer is defined as the major component to instruct the dialog manager; discriminate the skill and knowledge level of the user; predict the goal of the user; and monitor the quality of service.

In summary, the proposed intelligent interface integrated services environment exhibits the following interesting features. First, it differentiates a business user into different levels according to the skill and knowledge level of the users. It then provides an adaptive interface to complete business transaction process for the user. Second, it identifies the content of the EC transaction and depicts them into the EC transaction ontology clearly. The ontology may provide great helping for the users in intelligent interface. Third, it uses the agent pattern library to instantiate and dispatch appropriate anytime information agents to collect the

transaction data. These agents can be endowed with different tasks in the information collection process within the divergence data sources. Fourth, the user modeling separates the user classification into two phases. It discriminates the users into different groups by adopting the fuzzy ART neural networks. It then uses the fuzzy measurement to evaluate the levels of the user according to its skill and knowledge level. Finally, it uses CBR and fuzzy Petri-Net to predict the possible business plan and browsing behavior.

Acknowledgements

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