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A SYSTEM ARCHITECTURE FOR APPLYING INTELLIGENT AGENTS TO SUPPORT BARGAINING IN ELECTRONIC STORES

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Abstract

In this study, we propose a system architecture to support bargaining in electronic stores. Two types of application agents, UI (user interface) agent and bargaining agent, are presented in the architecture. To work out each intelligent agent well, we provide intelligent agents with main data sources by creating consumer database, bargaining history, product database, strategy database, and tactics database. Based on the system architecture, we have developed a system prototype and carried out a laboratory experiment to illustrate the value of the bargaining function in electronic stores.

Keywords: Electronic commerce, electronic stores, price bargaining, intelligent agents

Introduction

The explosive growth of the World Wide Web over the past years has greatly increased interest in its potential use of electronic commerce, especially as a vehicle for transactions. To provide consumers online shopping service, more and more suppliers set up electronic stores over the Internet. Plenty of electronic stores can provide consumers with more opportunities to select a compatible supplier over the Web. But this also gives web managers and designers a challenge, that is, how to draw consumer to shop around in their electronic stores.

In order to reach this goal, web managers and designers have made an effort to build a convenient shopping setting. To delegate some transaction activities to intelligent agents is the way to construct such an environment. Providing on-line intelligent assistance to facilitate the purchasing process of consumers has become more and more popular in web stores. However, most of them still focus on information search and evaluation assistance. Since consumers purchase interaction includes information search, evaluation, bidding and negotiation, it is necessary to provide consumers with further shopping assistance.

In traditional markets, administered pricing, bid pricing, and negotiate pricing are three common ways for determining prices of products (Pride and Ferrell 1991). Over the Web, however, most electronic stores primarily focus on administered pricing, in which the seller determines the price for merchandise and the customer pays that specified price. Although bidding and collective negotiation are available on the web sites now, price bargaining is still absent. Since a number of transactions are made through negotiated exchange, in which price and other terms are set via bargaining behavior, it is interesting to study how to construct the bargaining environment in electronic stores. Therefore, the purpose of this study is to investigate the system architecture for applying intelligent agents to support bargaining in electronic stores. The results will allow us to have better understanding to incorporate bargaining and intelligent agent in electronic commerce.

The rest of the paper is organized as follows: Firstly, we would like to briefly outline the literature on bargaining and intelligent agents. Secondly, we would like to present the architecture for applying intelligent agents to support bargaining in electronic stores. At length, we will complete the paper with a discussion of the experimental results and implications for researchers and practitioners.

Literature Review

Bargaining

Negotiation, or bargaining that is usually used interchangeably, is a process in which the representatives of two or more parties come together explicitly in search of an agreement on an issue about which they are divided. The bargainers will map out a

bargaining plan for a good chance of achieving the negotiator's objects. And the bargaining plan consists of bargaining strategy and bargaining tactics, and it is used throughout the bargaining process and implies a commitment to an overall approach to be taken with the bargaining opponent. To begin with, bargaining strategies differ from each other in many dimensions, including initial offer, concessive sizes, and rates of making concessions. On one hand, Siegel and Fourker (1960) define tough strategy as one that makes a high opening offer followed by infrequent, small concessions. Their recommendation for success in bargaining is that a bargainer should follow the toughness principle. Osgood (1962), on the other hand, proposed soft strategy and argues that one side should initiate concessions. He presents that a bargainer who makes unilateral concessions will thereby remove the main obstacle from his opponent's concession making. Besides, other researchers have raised another strategies, such as intermediate strategy and fair strategy (Schelling 1960).

In addition to bargaining strategy, researchers have also examined bargaining tactics. A bargaining tactic is a position or maneuver to be taken in a specific point in the bargaining process (Hammer 1974). With the use of tactics, we can alter the other party's perception of his bargaining power and his estimate of his own bargaining power as well as that of the balance of the two. We can also manipulate the resources and constraints in the environment to maneuver dependence and uncertainty in order to change the mechanics of power. Traditionally speaking, bargaining tactics are divided into two basic types. One involves an attempt to change the opponent's perception of his own power. The other involves an attempt to change the opponent's perception of the party's power (Bacharach and Lawler 1981). Classic bargaining tactics include limited authority, wet noodle, whipsaw/auction, and trial balloon, etc.

Intelligent Agent in Electronic Commerce

The intelligent agents are computerized programs that attempt to imitate the reasoning processes and knowledge of experts in solving specific types of problems (Maes 1994). They use knowledge base that have acquired from human domain experts to perform the task intelligently. On the Internet, applications of intelligent agents are comprehensive. To go with the stream, they have concentrated on developing efficient Web search mechanism, which identifies Web sites through keyword search of a database that extends throughout the Web. In addition to search engine, researchers also pay more attention on intelligent Web browsing. Letizia, for instance, working with Web browser can monitor users' browsing behavior and trace their following links, initiating searches, and ask for help (Lieberman and Maulsby 1996). It can analyze related Web page and provide personalized recommendations continually. Siteseer bases on an individual's bookmarks to recommends Web page, which has been bookmarked by other users who present the same interests as him or she (Rucker and Polanco 1997).

The transaction process in electronic commerce is often complicated. Integrating multiple agents to provide more powerful support seems feasible in the future. Recently, researchers have been discussing how multiple intelligent agents can support electronic commerce. To illustrate this point, Liang and Hwang (1999) review and discuss activities and structures of electronic markets with respect to the coordination mechanism and primitive activities. They analyze intelligent agents and developed a three-layer architecture for organizing intelligent agents to facilitate electronic commerce. Lai and Yang (1998) employ several intelligent agents for improving browsing activities on the Internet bookstores. They present five kinds of browsing agents: recommendation agent, new-contents agent, search agent, customized agent, and personal-status agent. In order to support these agents, a user analyzer is proposed to maintain the user profile by analyzing log file and CGI parameters, and site monitor to maintain the site database by monitoring all changes of the site.

To support negotiation in electronic commerce, Oliver (1996) develops artificial adaptive intelligent agents to learn strategy and participate in stylized business negotiations. Other related examples include Auction Bot, and General magic. These existing examples have showed the feasibility of applying intelligent agents to support bargaining. Nevertheless, these efforts primarily focus on the bidding, auction, Business-to-Business negotiation or collaborative bargaining. Seldom do they focus on investigated Business to Consumer price bargaining.

System Architecture

According to the above discussion, we propose system architecture for support bargaining in electronic stores as Figure 1. In the architecture, we apply the cooperation of multiple agents to bargain with consumers. Good data resources are necessary in order to work out each intelligent agent well. Consumer database, bargaining history, product database, strategy database, and tactics database provide intelligent agents with main data sources. And the definition of agents has a summary in the Table1. We use percept that describes the messages received by the agent and action that presented the behaviors of the agent to describe the goals of the agent. We will discuss these components in detail in the following sections.

UI Agent

UI (User Interface) agent is the interactive interface between consumers and the system. Since individual difference is one of the major determinants of bargaining behavior (Harnett and Cummings 1980), it is necessary to record the consumer personal information. Consequently, UI agent will ask him/her to register his/her personal information when a consumer visits the system for the first time. UI agent will analyze consumer's information and write cookies into the client site. A cookie allows the UI agent to tag the client site with a unique identification. When a consumer visits the system again, UI agent will request the unique cookies from the visitor's browser and pass the cookies to bargaining agent.

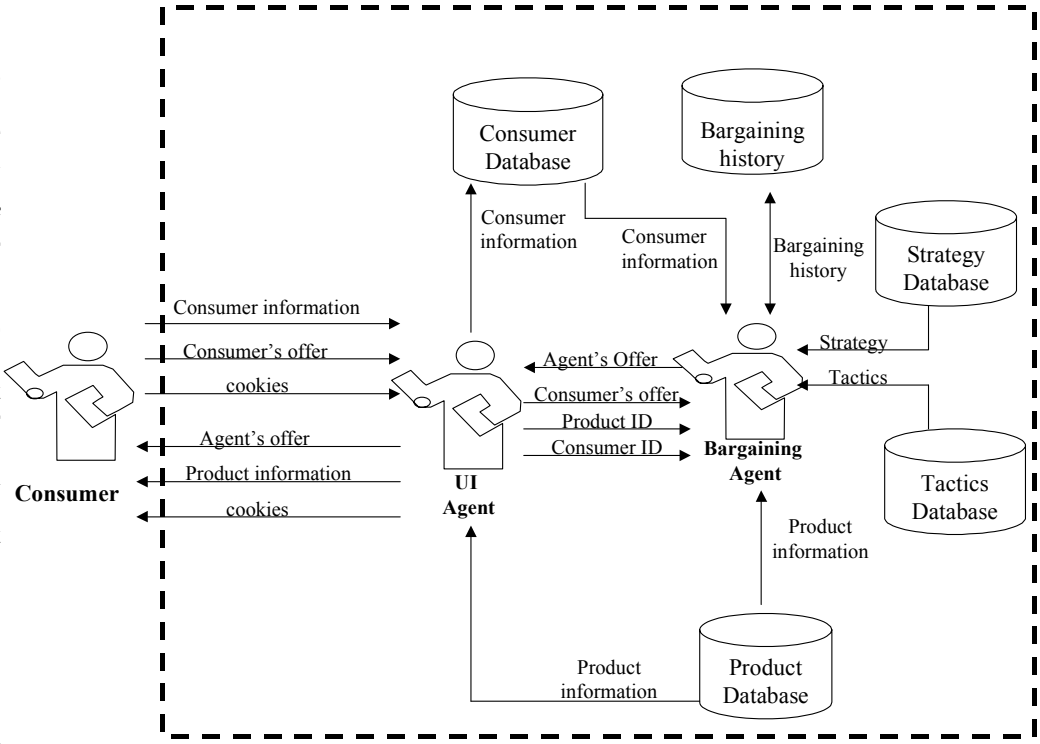

Figure 1. The Architecture for Applying Intelligent Agents to Support Bargaining

Monitoring the consumer's browsing behavior is another goal of UI agent. UI agent traces the consumer's hyperlink to retrieve related information. If the consumer is interested in the specific item and wants to perceive more data, the UI agent will retrieve the product specification and present the information to the consumer. UI agent will also demonstrate the price related the item that the consumer is interested in.

As for the traditional markets, not all items can be exchanged under negotiation in the bargaining store. Based on the consumer's browsing status and product database, UI agent can decide whether it will activate bargaining agent or not. While the item is negotiable and the consumer attempts to bargain, the UI agent will activate bargaining agent and pass the consumer's ID. Then, UI agent will receive the consumer's offer, pass to bargaining agent, and present the agent's offer to consumers until clinching a deal or failing in bargaining.

Bargaining Agent

The bargaining agent plays an important role in the system architecture. As mentioned above, the bargainers often develop a bargaining plan that consists of bargaining strategy and bargaining tactics to have a chance of achieving the negotiator's objects. Therefore, the bargaining agent will decide the offer and concession rate subject to the price of the product and bargaining strategy. Then the bargaining agent combines the offer with tactics and passes the result to UI agent.

The concession rate computation is based on the list price, reservation price, consumers' offer, and size of concessions. The concession rate is the mathematical function of concession size. The bargaining agent decides concession rate and concession size based on bargaining strategy and his knowledge base. That is to say, the greater the concession size is, the smaller the concession rate will be.

The history of the consumer's bargaining is also the critical factor for bargaining agent to decide the new announced initial sale price. If consumers have bargained with the same item, the final price of last bargaining round will be the agent's initial offer. If consumers bargain with a new item, the bargaining strategy will decide the agent's initial offer.

Table 1. The Definitions of Agents

Agent Type	Percept	Action
UI agent	❶ Consumer information ❷ Consumer offer ❸ Cookies ❹ Agent offer ❺ Product information	❶ To collect consumer's information. ❷ To receive consumer's offer. ❸ To monitor consumer's browsing behavior and activate bargaining agent ❹ To request cookies from client. ❺ To present agent's offer and product information to consumers. ❻ To write cookies into client.
Bargaining agent	❶ Consumer ID ❷ Product ID ❸ Consumer's offer ❹ Product information ❺ Strategy ❻ Tactics ❼ Bargaining history ❽ Consumer information	❶ To analyze consumer's information, offer, and bargaining history ❷ To decide offer based on bargaining strategy, bargaining tactics and price of product. ❸ To Retrieve product information.

Prototype

According to the system architecture, we choose Microsoft IIS as Web server to build an electronic shopping mall. Active Server Page (ASP) and Virtual Basic Script are the programming tools. The initial product database in the shopping mall is shown in the Table2. And each item contains product ID, product name, list price, reservation price, negotiable information, and product specification. Among these items, CD-ROM, monitor, printer, and scanner are set as negotiable.

Table 2. The Product Database

Product ID	Product name	List price*	Reservation price*	Negotiable	Product spec.
P0001	DVD	12,000	10,000	N	…
P0002	CD-ROM	15,000	12,000	Y	…
P0003	Monitor	15,000	12,100	Y	…
P0004	Printer	15,000	12,000	Y	…
P0005	Scanner	15,000	10,000	Y	…
…	…	…	…	…	…

*The monetary unit is NT dollars; 1 US$= 35 NT$

We also modify soft, hard, and intermediate bargaining strategy to initiate a strategy database. And the bargaining strategy database is shown in the Table 3. Each bargaining strategy consists of initial offer, concessive sizes and concession rates. Among these strategies, UDC strategy is defined as the highest opening bargaining discount, followed by smaller and smaller size of concessions. This strategy makes individual perceive the bargaining utility as decreasing. UIC strategy is defined as low initial bargaining discount, which are followed by larger and larger size of concessions. This strategy causes individual to perceive the bargaining utility as increasing. UIT strategy is defined as intermediate opening offer, which are followed by fixed size of concessions. In the end, we also create a tactics database, and its example is shown in the Table 4. It includes several classic bargaining tactics, inclusive of limited authority, whipsaw/auction, and the well is dry, etc.

Table 3. An Example of Strategy Database

Strategy ID	Strategy name	Initial offer	Concessive sizes	Concessions rates
S001	UDC	6.7%	4.3%, 3.0%, 2.3%, 1.6%, 1.6%, 0.8%, 0.8%	15%, 30%, 50%
S002	UIC	0.67%	1.34%, 2.04%, 2.78%, 3.57%, 3.70%, 3.85%, 4.0%	15%, 30%, 50%
S003	UIT	2%	2%	15%, 30%, 50%
…	…	…	…	…

Table 4. An Example of Tactics Database

Tactics code	Tactics name	Tactics Content
T001	Limited authority	I must check with my boss.
T002	Whipsaw/ auction	I am negotiating with several competitors at the same time. You must make decision quickly.
T003	The well is dry	I have no more concessions to make.
…	…	…

Scenario

Vincent connects the shopping mall and he wants to buy the computer peripheral. From cookies and consumer database, UI agent finds out that Vincent never visits the mall. As a result, UI agent will ask Vincent to fill out an electronic form to register his personal data in the beginning. Then UI agent creates a user ID and writes the data into consumer's database automatically. UI agent also writes a cookie into the client site. Here is an example of Vincent's cookies in the Table 5. It records the consumer's ID, name, and the domain name of the web site that has authority to update the cookies.

Table 5. An Example of Cookies

```
Response.cookies("user_id")= "U0002"
Response.cookies("user_id").Domain="www.ecbargain.com.tw
Response.cookies("name")= "Vincent"
Response.cookies("name").Domain = "www.ecbargain.com.tw"
```

After browsing the mall, Vincent may have interest in scanner and need more information. UI agent reads the product specification according to the product ID and presents the product specification to Vincent. From the product database, UI agent finds out that the price of scanner is negotiable. Vincent only wants to pay $11,000 for the scanner so he can ask the UI agent to lower the price. UI agent activates the bargaining agent and passes the consumer ID. The bargaining agent chooses the UDC bargaining strategy from strategy database and request price information of the scanner from product database. Based on Vincent's inquiry and initial offer of UDC strategy, the bargaining agent combines the limited authority tactics and says, "Vincent, I cannot sell any scanner which is less than $11,000. Your offer is too low. But my boss tells me that I can sell you at the price of $14,000." Vincent doesn't accept the agent's offer and continues to input his asking price. Based on bargaining strategy, the bargaining agent announces his new offer of $13,400. If Vincent doesn't accept the offer and leaves the bargaining store, the final round of bargaining result is recorded in user bargaining history as Table 6. Next time while Vincent visits the bargaining store again, the initial offer of the bargaining agent will become $13,400. The bargaining agent will still base on UDC strategy to bargain with Vincent until clinching a deal.

Table 6. An Example of Bargain History

User ID	Product ID	Date	Time	Agent strategy	Agent offer	Purchase
U0002	P0005	1998/12/21	17:12:18	S001	13400	N
U0005	P0004	1998/12/21	11:12:19	S002	13500	N
…	…	…		…		…

Discussion and Implication

In order to verify the value of the proposed agents, we carry out a laboratory experiment. We set up twenty electronic stores in the shopping mall, and provided four stores with bargaining agents. A total of 105 undergraduate students participate this experiment. They are asked to buy CD-ROM, monitors, printers and scanners in the electronic stores. Only one particular brand and model is available for each item. Except bargaining function, we try to maintain the same level of presentation content between twenty stores in the mall.

The price distribution in the shopping mall is described as Table 2. If the subject visits the bargaining store and wants to bargain, the bargaining agent will randomly select one of the three bargaining strategies as Table 3 and tactics to bargain with him/her.

The reservation price is the best price for subjects when finishing bargaining. A subject might get a final price that is greater, equal, or smaller than other bargaining stores in the shopping mall. From the history of the bargaining, we find that all subjects try to bargain with computer agent and sixty-six percentages of subjects shop in bargaining stores. The result of the experiment indicates numbers of the subjects who have purchased in bargaining store are significantly larger than the ones who have purchased in other stores (p-value=0.002).

Since the Internet has been so flooded with electronic stores, web managers and designers need to make more effort to build a convenient shopping setting. In order to satisfy the consumers, this study proposes the system architecture to support bargaining in electronic stores. To sum up, this study has the following contributions. At the first place, we propose the system architecture for supporting bargaining in electronic stores. Then we apply the cooperation of multiple agents to bargain with consumers. On the basis of the system architecture, we develop a system prototype. We also describe how the agents work and demonstrate the way of data resource utilization. Moreover, we conduct a laboratory experiment to illustrate the value of the bargaining function in electronic stores. The experimental result shows that consumers will prefer shopping in the bargaining store. This research has provided a starting point for studying bargaining mechanism in electronic stores. The future research can be applied on intelligent agent to build bargaining function in a real electronic shopping store and test their effect.

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