

# The Research of Intelligent Negotiation Agent - Application for B2C E-commerce

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**Abstract**—B2C e-commerce is becoming more widespread as more people come to recognize its convenience and its ability to rapidly respond to requests and as more products and services become available. However, many electronic marketplaces, especially in the business-to-consumer, are in essence some kind of search engine where buyers look for the best product in a database of products offered by sellers. In an automated negotiation, intelligent agents engage in broadly similar processes to achieve the same end. In more detail, the agents prepare bids for and evaluate offers on behalf of the parties they represent with the aim of obtaining the maximum benefit for their users. Nevertheless, in the current situation, price is the only criterion by which agents are created. This factor is easy to measure and automate. However, the criteria for advanced transactions need to be elaborated, for example, details of giveback and dividend. In this paper, we present a multiple-attributes negotiation model for B2C e-commerce, which deploys intelligent agents to facilitate autonomous and automatic on-line buying and selling by intelligent agents while quickly responding to consumers. These include a 4-phase model, information collection, search, negotiation, and evaluation. We also apply fuzzy theory and analytical hierarchy process to develop the system interface to facilitate the user inputs. Finally, an example of the notebook purchasing process is illustrated.

**Index Terms**—Intelligent agents; Multiple-attributes; Negotiation; B2C e-commerce

## I. INTRODUCTION

The internet offers consumers greater benefits from increased information and lower transaction costs, which includes search costs. There are more choices than in the traditional economic environment. At present, B2C e-commerce offers functions focusing on catalogue browsing, term screening and search. Customers have to spend much time searching and scanning to find products which achieve their demands. It can see although users can get a lot of information, it will take much time to filter useful information. In addition, more information does not mean higher efficiency. Although people can buy goods at home, they cannot avoid spending much time reviewing products on internet. Software agent technology is a new approach in e-negotiations. Use of software agents to represent the negotiating parties could greatly decrease efforts and the time needed to complete negotiations. Intelligent agent software is the action of human decision-making behavior in the form of a computer program. Intelligent agent software can help users to perform some actions involving search, negotiation, trade off and so on to improve effectiveness. It also improves the consumer's bargaining position with the opposition from the internet and traditional channels. A Negotiation Support

System (NSS) refers to a specialized group support system designed to help negotiators achieve optimal settlements [1]. [2] present an agent-based negotiation support system having the following functionalities: Information sharing among stakeholders, Auto-negotiation between agents, and Modeling of group decision making. [3] proposed an agent negotiation protocol which depends on utility, similar to the analytic approaches. Much effort has been spent on designing agents for automated negotiation [4]. However, traditional e-marketplaces do not use agent technology even though agents could significantly improve the services provided both for the buyers and the sellers. Moreover, prior research only focused on how to achieve maximum profit. The criteria for advanced transactions needs to be elaborated, for example, details of giveback and dividend. Therefore, this paper proposes a multiple-attributes negotiation model for B2C e-commerce.

## II. A SOLUTION APPROACH OF INTELLIGENT AGENT TO NEGOTIATION

In this section, an agent-based architecture called an intelligent negotiation agent (INA) architecture is designed to enhance the existing B2C e-commerce process rather than to modify it, although the process may be modified before such a system is built. The INA researches both the technology and the methods needed to improve the way information is gathered, managed, distributed and utilized to decision-makers in key business functions and operations. Several researches have studied agent architecture. [5] proposed a model for the buyer agent consisting of three main components: a coordinator, several negotiation threads and a commitment manager. And some researchers claimed three key processes are needed to make the agent work effectively and simulate the real world buying experience: Identifying a proper set of criteria on which to transact, Identifying agents with whom to transact, Negotiation [6]. The Kasbah e-marketplace is one of the early attempts at exploiting agent technology for automated negotiations in eCommerce [7]. Buyer agents and seller agents proactively seek out potential buyers or sellers and negotiate with one another on behalf of their owners. The objective of each agent is to complete an acceptable deal based on the user-specified constraints such as initial asking (or bidding) price, a reservation price, a date by which to complete the transaction, and restrictions on which parties to negotiate with and how to change the price over time [8].

In this paper, INA architecture which includes buyer agents and seller agents is proposed. Buyer agents can search products, and negotiate and access negotiation records. The seller agents negotiate with the buyer agent and access products and a consumer database. The architecture

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characteristics:

- **Intelligent:** The agent automatically customizes itself to the preferences of its customer (or client), based on previous experience and imprecise information from interaction with customers. The agent also automatically adapts to changes in its environment.
- **Autonomous:** An agent is able to take the initiative and exercise a non-trivial degree of control over its own actions through service agreements.
- **Cooperation:** An agent does not blindly obey commands, but makes suggestions to modify requests or asks clarification questions. It also cooperates with other agents to query the modules needed.

In the INA system, each INA is able to perform one or more services (Fig. 1). A service corresponds to some problem solving activities of negotiation. Service requirements are issued either from the other department, for example, the purchase department through an Intranet, or from external customers through the Internet. Services are associated with one or more agents responsible for managing and executing those services. Each service is managed by one agent, although executing its sub-services may involve several other agents. The activities of the INA agents involve:

- Selecting products to satisfy the requirements of customers
- Evaluating and Negotiating the products into an integrated service
- Coordinating and scheduling the processes intelligently.

All INAs have the same basic architecture. This involves an agent body responsible for managing the agent's activities and interacting with peers and an agency representing the solution resources for the problems of product negotiation processes. The body has several functional components responsible for each of its main activities – for example, the buyer agent, interfacing with users, searching for desired products, negotiating with sellers and managing the tasks; the seller agent, interfacing with users, negotiating with buyers and managing the tasks.

### III. NEGOTIATION MODEL

The negotiation model includes negotiating a decision function and uses fuzzy theory and Analytical Hierarchy Process to obtain the product utility. After that, apply the product utility to negotiate for the following purposes: First, decrease the time of filter product information. Second,

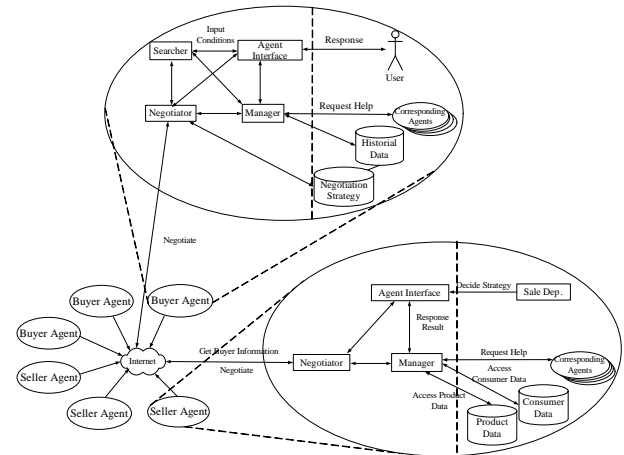


Fig. 1. Intelligent negotiation agent (INA) architecture  
decrease the negotiation time. Third, meet buyer's preference and maximize the user's utility. The negotiation process can be divided into four stages, which includes information collecting, searching, negotiating, and evaluating. Fig. 2 shows the negotiation processes workflow. The first stage includes inserting product search and negotiation conditions, setting the product attribute membership function, comparing product attributes and applying AHP to calculate attribute weights. The second stage works according to search conditions the user inserts. And then an INA agent searches for products from the Internet and gets the sellers' information response to the user. Third, an INA agent starts negotiation by the search result and calculates product utility and determines whether to receive the product or not. Finally, the negotiation evaluation state is the final state of negotiation which the buyer agent and seller agent determine when to finish.

### IV. PROTOTYPING SYSTEM

In this paper, an open e-commerce platform is developed to validate the proposed negotiation model. We adopt JBuilder2005 as software development tools and MySQL as database system. The source of data is collected from the market. Agents used in the prototyping system are divided into two sets of buyer agents and seller agents. The sellers provide the information about the products on e-commerce platform through the seller agent. The buyer also filtrates, searches and negotiates with the seller through the buyer agent. The four negotiation stages presented above are described and shown below.

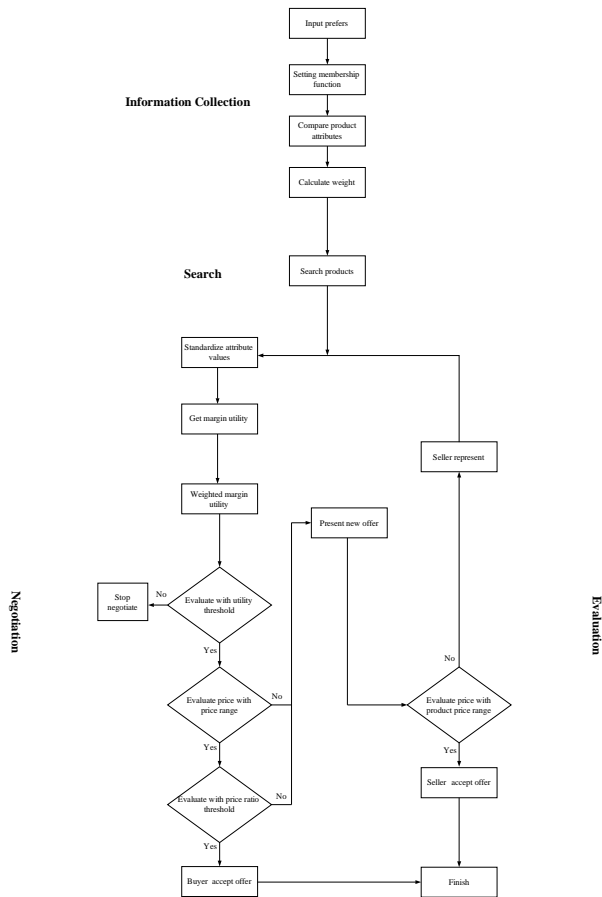


Fig. 2. Negotiation Processes

#### A. Information Collection Stage

Before negotiating, a buyer agent asks the user to login to the system and input preference, related settings which include price ratio, price range, product specifications, giveaway and preference (Fig. 3). The membership function of the product setting is to let the user to set all product attributes to carry on the follow-up negotiation by the agent. After setting the membership function of the products, we can obtain the attribute margin utility value and divide the parameters into the left value, middle value and right value according to the membership function (Fig. 4). The system then asks the user to compare the product attribute. The system calculates the product attribute weight by the AHP (Fig. 5).

#### B. Search Stage

After the buyer inputs the search conditions and defines the membership functions, the agent goes to the next stage and searches for products from the e-commerce platform (Fig. 6).

The screenshot shows a 'Demand Setting' window with various input fields for product specifications and negotiation parameters. The fields include Price Range (15000 to 25000), CPU (1.5 GB up), Memory (512 MB), Hard Disk (80 GB up), Dividend (Yes), Giveback (Yes), DVD Burner (Yes), Unit Increase Value (20), and Price Ratio Threshold (0.95). A note at the bottom states: '\*The value of price ratio threshold must be between 0 to 1.' There is a 'Setting' button at the bottom left.

Fig. 3. Buyer Demand Setting

The screenshot shows a 'Membership Function Setting' window with multiple rows of input fields for different product attributes. The attributes are categorized into five levels: Very Cheap, Cheap, Normal, Expensive, and Very Expensive. Each category has 'Upper Limit' and 'Lower Limit' fields. The attributes being set are Price, Spec, Giveback, and Dividend. A 'Price Set' section includes 'Start Value' (0) and 'Add' (1000). There is a 'Setting' button at the bottom left.

Fig. 4. Membership Function Setting

The screenshot shows an 'AHP' (Analytic Hierarchy Process) window for weight calculation. It contains several comparison questions with dropdown menus and numerical values. The questions are: Price v.s. Spec. (Little Important, 3.0), Price v.s. Dividend (Important, 5.0), Price v.s. Giveback (Absolutely Important, 9.0), Spec. v.s. Dividend (Important, 5.0), Spec. v.s. Giveback (Important, 5.0), and Dividend v.s. Giveback (Coordinate, 1.0). There are 'Calculate', 'Before', and 'Next' buttons at the bottom.

Fig. 5. The Weight Calculation by the AHP

	pid	brand	Product_name	CPU	Memory
1	1	ASUS	V3-PH2E630D-B5RE	Pentium D-805/2.66G	DDR2 667 1GB
2	2	HP	Pavilion a5030nw	Intel Core 2 Duo E4300 (1.8GHz)	DDR867 1G
3	3	ASUS	V2-PE18150D-75BA	Intel Pentium-D 915 (2.8GHz)	DDR2 512MB (Max: 2GB)
4	4	Acer	Power FH	Core 2 Duo E4300/1.8G	DDR2 667 1GB (Max: 4GB)
5	5	Acer	Power FH E4300	P4-935 3.2G	DDR2 667 1GB (Max: 4GB)

Fig. 6. Product Search

#### C. Negotiation Stage

First, the buyer agent calculates the attribute utility. Second, apply a utility function and attribute weight to obtain the product utility. In this system, the seller agent has two columns in negotiation. The left column shows the information of the offer from both sides. The right column shows the trade processes including the products and prices. In the buyer agent negotiation, the right column shows the negotiation processes containing the buyer's offer and seller's offer. Finally, when the negotiation ends, it shows the products and prices both sides can accept (Fig. 7 and Fig. 8).

#### D. Evaluation Stage

When the buyer agent receives offer from the seller agent, the buyer agent first compares the offer with the buyer price range. The price which the seller agent presents must be lower than the upper limit. After that, the buyer agent also evaluates the product utility which must larger than utility threshold. On the other hand, if the buyer agent does not receive seller agent prices, then the buyer agent calculates new prices and presents them to the seller agent. After receiving the buyer agent prices, the seller agent checks the prices which must be larger than the lower limit of the price range.

## V. CONCLUSION

In this paper, we present a multiple-attribute negotiation model for B2C e-commerce deploying intelligent agents to facilitate autonomous and automatic on-line buying and selling while providing a fast response to consumers. The negotiation model includes a 4-phase model, information collection, search, negotiation, and evaluation. We also apply fuzzy theory and analytical hierarchy process to develop the system interface to facilitate the user inputs. In the end, an example of the notebook buying process is illustrated.

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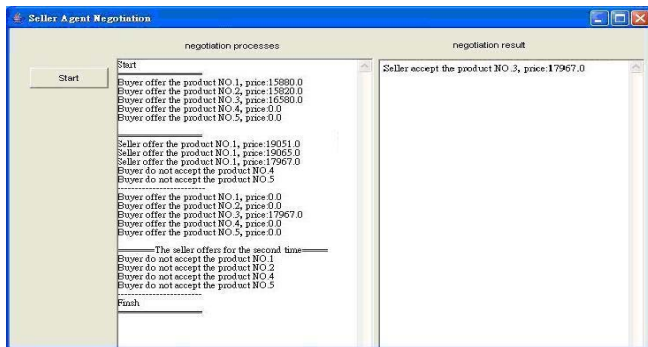


Fig. 7. The Seller Negotiation Process

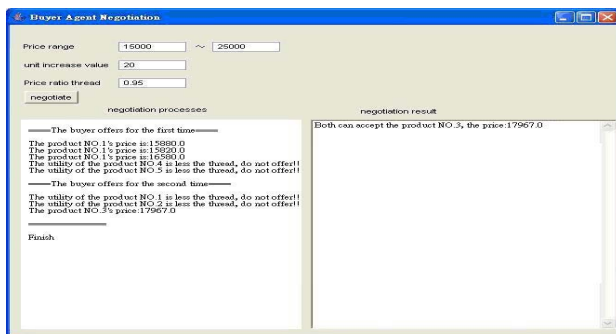


Fig. 8. The Buyer Negotiation Process

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