The Assessment of Intelligent Agent in the B2C E-Commerce Negotiation

Wen-Yau Liang

***Abstract*—An agent can be seen as a software and/or hardware component of system which is capable of acting exactingly in order to accomplish tasks on behalf of its user. However, intelligent agent is still quite a new technology and researches in this area primarily focus on developing technologies in agent systems itself, and research works which evaluate the intelligent agent performance are few and far between. This research applies intelligent agent to B2C e-Commerce negotiation. An experimental design is then used to collect experiment data and a questionnaire is conducted to investigate the benefits of intelligent agent systems. Results show that intelligent systems do improve performance of negotiation system, in both experiment and questionnaire analysis.**

***Index Terms*—B2C E-Commerce, Intelligent agents, Negotiation**

I. INTRODUCTION

Business-to-Consumer is similar in concept to the traditional method of retailing, the main difference being the medium used to carry out business by the internet. Such a method of carrying out business transactions assumes the consumer has access to the WWW. By selling direct to customers or reducing the number of intermediaries, companies can achieve higher profits while charging lower prices [1]. Negotiation is an inseparable component of many ecommerce activities, such as auctions, scheduling, contracting, and so on, and is one area that can greatly benefit from automation [2]. Negotiation is a very extensive subject spanning from pre-negotiation to post-negotiation analysis, both at the local and social level. Thus, a considerable amount of work on negotiation is available in literature from different domains, such as operational research, economics, and decision theory [3]. Negotiation in B2C commerce is a time-consuming process because all parties desire to maximize their own payoff while they may have opposing goals. If some of the parties do not concede, it could take forever to reach an agreement [4].

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 [5]. Morge and Beanue 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 [6]. Faratin et al. proposed an agent negotiation protocol which depends on utility, similar to the analytic approaches [7]. Much effort has been spent on designing agents for automated negotiation [8]. However, intelligent agent is still quite a new technology and researches in this area primarily focus on developing technologies in agent systems itself, and research works which evaluate the intelligent agent performance are few and far between. This research applies intelligent agent to B2C e-Commerce negotiation. An experimental design is then used to collect experiment data and a questionnaire is conducted to investigate the benefits of intelligent agent systems.

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II. INTELLIGENT AGENT ASSESSMENT

In recent years, intelligent agent has been researched quite extensively. Kuo et al. proposed a framework for collaborative intelligent agents in a distributed environment to execute sound security strategies for protecting information resources [9]. Xu and Qi study the key problem of determining the mobile agent itinerary for collaborative processing and model the dynamic mobile agent planning problem [10]. In the electronic commerce domain, the opportunities for using agents in e-commerce applications are enormous [11]. At present, the intelligent agent have used in B2C e-commerce negotiation, for example: Louta et al. proposed a dynamic multi-lateral negotiation model and construct an efficient negotiation strategy based on a ranking mechanism that does not require a complicated rationale on behalf of the buyer agents [12]. Huang and Lin design an intelligent sales agent, who can learn persuasion and bargaining strategies [13]. Lee et al. analyze the data with an agent-based procurement system (APS) to re-engineer and improve the existing procurement process, it such that the agent can enhance the negotiation and suppler evaluation efficiency by saving time and cost. Data repository stores the corporate data and the share data from suppliers and customers so as to let enterprise has better collaborative purchasing practices [14]. Huang et al. present a multiple-attributes negotiation model for B2C ecommerce, which deploys intelligent agents to facilitate autonomous and automatic on-line buying and selling by intelligent agents

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while quickly responding to consumers [15].

The intelligent agent assessment can be separated into case study and statistical study. Schetter et al. compared the centralized and hierarchical organizations on "CPU workload", "CPU time" and "communication data". Agent-based simulations of mission case studies show the autonomous operation of the multi-agent architecture, which can then be used to build, evaluate and compare autonomous software architectures for multiple satellite systems [16]. Ben-Ami and Shehory evaluate agents in open multi-agent systems (MAS) on "response time" and "hit rate" [17]. Huang and Lin proposed an intelligent sales-agent, ISA, equipped with persuasion and negotiation mechanisms to execute persuasion and bargaining strategies to interact with various buyers. Finally, a questionnaire is used to evaluate the system [13].

III. Research Method

The main purpose of the study is to verify the effectiveness of intelligent agent systems in B2C e-commerce. This study compares the differences between using and not using the agent system through the experimental design. In addition, a questionnaire of the experiment participants is used to assess the effectiveness of the agent system.

A. Research Model and Hypotheses

The research model was shown in Fig.1, which focuses on qualitative assessment and quantitative hypothesis. Delone and Mclean propose a model to measure the success of information systems, which system quality, suggests that information quality, **user satisfaction**, IS usage, individual impact and organization impact [18]. Boudreaux et al. uses the DARSSA consisted of **end-user satisfaction ratings**, completion times for the assessment module, and the proportion of patients with risky substance use that chose to receive a dynamic referral. It has the potential to improve identification of substance abuse in medical settings and to provide referrals that would not routinely be provided [19]. Herein, our first hypothesis:

H1：In the B2C e-commerce, offer the buyer negotiation agent, that has higher customer satisfaction.

Kwon et al. proposes a reservation price reporting mechanism (RPR) and its extended version (ERPR), the lab experiments are conducted to compare the performance of RPR, ERPR and the traditional direct bargaining (TDB), each negotiation session has **total number of sessions**, successful sessions, **average number of rounds**, **average total profit** [20]. Moulet and Rouchier use **the time buyers can spend on the market** and the frequency of update in learning by sellers, and have to validate the model, features produced by the simulated market are compared to the stylized facts gathered for negotiation about four goods [21]. Huang and Lin design a lab prototype of a sales agent with persuasion and negotiation capabilities and to evaluate its effectiveness as a virtual clerk in an e-store [22]. The experimental results reveal that an e-store embedded within such a sales agent can improve a seller's surplus and increase a **buyer's product valuation**, **willingness-to-pay**, and **satisfaction with the e-store** [22]. According to the above, this study will use Number of Negotiating Rounds, Length of Negotiating Time and Customer's Negotiating Gain as indexes to assess the negotiation agent system, three hypotheses were tested:

H2：In the B2C e-commerce, offer the buyer negotiation agent, that has less number of negotiation rounds.

H3：In the B2C e-commerce, offer the buyer negotiation agent, that has quicker negotiation time.

H4：In the B2C e-commerce, offer the buyer negotiation agent, that has higher negotiation gain.

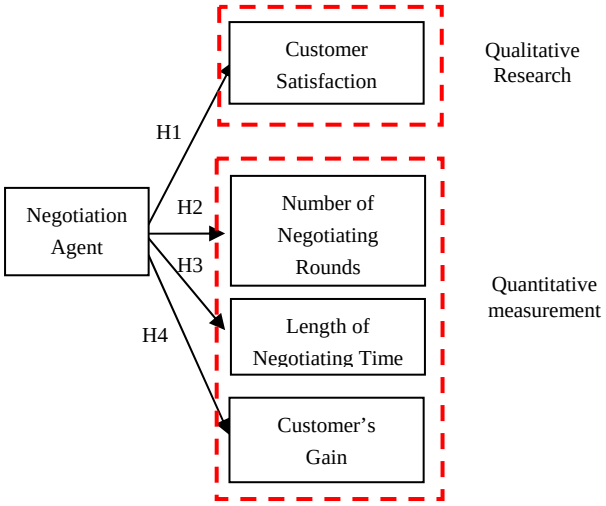

Fig. 1 Research model

B. Experiments Design

Participants were randomly divided into Group A and Group B. Group A is to use the buyer negotiate agent and Group B is not. The participants were the graduate student in the university, a total of 60 participants in the experiments. Past studies have shown that purchase intention will be affected by the product [23]. Thus, both groups were offered the same desktop PCs to negotiate to ensure that the experiment in the Group A and Group B have the same conditions. The experiential process is shown in Fig. 2.

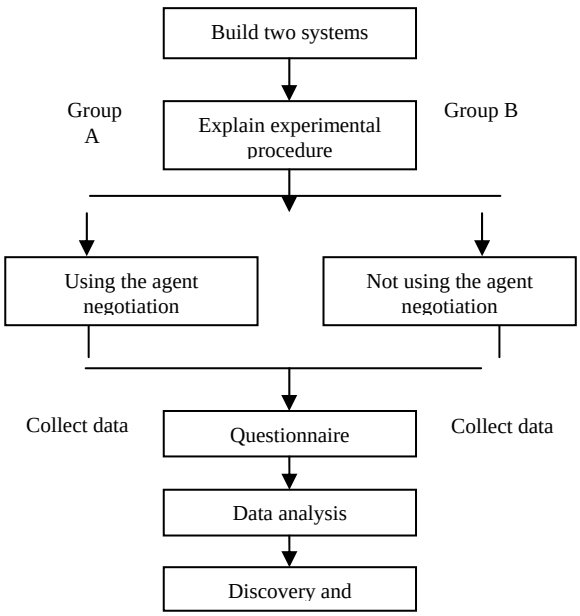

Fig. 2 Experiment processes

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In this paper, a prototyping intelligent agent system is created in java for Group A. Group A is to use buyer negotiation agent to negotiate with the seller. The major functions are: Login, setting membership function, shown the products and negotiation.

In this paper, both buyer agents and seller agents own their negotiation strategy. Buyer strategy refers to the offer method of buyer agents and the stop conditions. The new offer is calculated according to the total utility of products and the offering function [24]. Besides the current offer, the buyer agent must know when to stop the negotiation. In this paper, we present two conditions where both of them must be reached and then agents can decide to trade or not. The first condition is the product price which the seller agent presents must be within the buyer offer range. The second condition is the ratio of buyer offer and seller offer must be larger than a threshold defined by the buyer in the initial negotiation stage.

IV. Data analysis

Data analyses were conducted by using the software SPSS 12.0. In the qualitative analysis, the use of statistical methods include: Mann-Whitney test, Reliability analysis, Validity analysis and T-tests. This study use quantitative survey to test inferred hypotheses empirically, in the quantitative measurements, using T-tests as a method of testing hypotheses.

A. Qualitative Analysis of Negotiation Agent

The study use two single sample T-tests to exam if offering the buyer negotiation agent has higher customer satisfaction. The analysis of SPSS is shown in Table 1. All correlations were significant with p-value < 0.05, the research model was able to explain: t-value = 2.534, p= 0.007, it was significant of difference, the Group A (using the negotiation mechanism of the buyer agents) has higher customer satisfaction than the Group B (not using an agent negotiation mechanism for the buyer).

Table 1 T-tests- Qualitative analysis

	Groups	Average	Standard deviation	t-Value	p-Value
1. The shopping system to provide personalized service.	Group A	4.00	0.525	2.048	0.023*
	Group B	3.60	0.932		
2. The shopping system provides a convenient shopping.	Group A	3.90	0.548	1.316	0.097
	Group B	3.67	0.802		
3. The shopping system to help me do better shopping determine.	Group A	4.13	0.571	2.766	0.004*
	Group B	3.53	1.042		
4. I am satisfied with the consultation process.	Group A	4.13	0.776	1.173	0.122
	Group B	3.87	0.973		
Satisfaction with the overall dimensions of test	Group A	4.0417	0.42081	2.534	0.007*
	Group B	3.6667	0.69274		

∗ $p < 0.05$

B. Quantitative Analysis of Negotiation Agents

In the study, two independent sample T-tests detected whether there are significant differences in Number of Negotiating Rounds, Length of Negotiating Time and Customer's Negotiating Gain. SPSS analysis results in Table 2.

Table 2 T-tests –Quantitative Analysis

	Groups	Average	Standard deviation	t-value	p-value
Number of Negotiating Rounds	Group A	20.60	22.807	0.952	0.177
	Group B	15.87	14.887		
Length of Negotiating Time(seconds)	Group A	0.013	0.014779	-6.389	0.000*
	Group B	95.29263	81.676791		
Customer's Negotiating Gain(%)	Group A	0.13072	0.033992	-1.736	0.044*
	Group B	0.11241	0.046706		

∗ $p < 0.05$

C. Discussion

In the qualitative analysis, the research model was able to explain and the Group A (using the negotiation mechanism of the buyer agents) has higher customer satisfaction than the Group B (not using an agent negotiation mechanism for the buyer). Although Item 2" The shopping system provides a convenient shopping." and Item 4" I am satisfied with the consultation process. " did not reach level of significant. It could be inferred that both group are satisfied the negotiating function (by agent or manually) provided by the system since few e-commerce web sites have this function.

In the quantitative analysis, the research model was able to explain and the Group A (using the negotiation mechanism of the buyer agents) spends less negotiating time and gets more customer's gain than the Group B (not using an agent negotiation mechanism for the buyer). There is no significance between Group A and Group B in number of negotiating rounds. Previous study had pointed out that in B2C e-commerce Negotiation is often a time-consuming process. If some of the parties do not concede, it could take forever to reach an agreement [4]. It could be inferred that some group B participants had increased the new offer quickly to complete the transaction while group A had to follow the preset the unit increase value to increase the new offer(by agent).

V. Conclusion

Much effort has been spent on designing agents for automated negotiation. However, research works which evaluate the intelligent agent performance are few and far between. This research applies intelligent agent to B2C e-Commerce negotiation. An experimental design is then used to collect experiment data and a questionnaire is conducted to investigate the benefits of intelligent agent systems. Results show that intelligent systems do improve performance of negotiation system. In the qualitative analysis, the research model was able to explain that use the negotiation mechanism of the buyer agents has higher customer satisfaction. In the quantitative analysis, using the negotiation mechanism spends less negotiating time and gets more customer's gain.

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