Socio Economic Psycho Knowledge Based Intelligent Agents for Automated e-Commerce Negotiation

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Abstract. Automated Negotiation is a process in which two or more parties with different criteria, constraints, and preferences, jointly reach an agreement on the terms of a transaction through an automated constraint satisfaction and preference selection mechanism. In practical real environment the process of negotiation is not very strictly a mechanical selection or constraint satisfaction. It is based socio economic psycho conditions. One-to-many negotiation framework is taken as the default to test this socio economic psycho knowledge incorporation. In these cases of auctions, online trading needs a greater flexibility. Therefore it needs different strategies with different opponents. In this paper, an attempt is made to incorporate the socio economic psycho knowledge in the process of negotiation. All agents working on behalf of one party negotiate individually with other parties. After each negotiation cycle, the group of these agents report back to a coordinating agent that evaluates how well each agent has done, and issues new instructions accordingly. Each individual agent conducts reasoning by using socio psycho knowledge constraint-based technique with the objective of overall profit for both sides. We outline two levels of strategies that can be exercised on two levels, the individual negotiation level, and the coordination level. In our prototype Intelligent Trading Agency (ITA), agents autonomously negotiate multi-attribute with socio economic psycho consideration terms of transactions in an e-commerce environment tested with a personal computer trading scenario.

Keywords: Automated Negotiation, Intelligent Trading Agency, Socio-economic Psycho Knowledge.

1 Introduction

Electronic Commerce [1] has unleashed yet another revolution, which is changing the way businesses buy and sell products and services. Modern age of busy life leaves no time space for negotiated purchase. A business organization can organize itself to conduct e-commerce with its customers. The Business-to-Customer or Customer-to-Customer trading technique requires different automated tools and mechanisms to assist the customer over the trading environment to save time and achieve their

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objectives in understanding practical conditions. As a result we try to develop new methodologies for automated decision making and negotiation strategies.

Online trading provides various types of sophisticated facilities for different products procurement and sales. The application of multi-agent [2,3,4] in automatic negotiation focus on negotiation process design, environment and its three dimensions, negotiation protocol, model and strategy under the bilateral negotiation with multi-attribute. These software agents can also play an important role in providing automation and support for the negotiation stage of online trading [5]. Different types of negotiation scenarios exist ranging from one-to-one to one-to-many, many-to-many [6]. In this case only very limited knowledge is used for negotiation and most of the approaches consider only three or four attributes for negotiation.

Cyber psychology [7, 8] explores the psychological aspects of environments created by computers and online networks. It presents an evolving conceptual framework for understanding how people react to and behave within cyberspace: what is called as "the psychology of cyberspace" - or simply "cyber psychology". Most existing e-commerce system's negotiation mechanisms have been focusing on the technical efficiency and adopting mechanical strategies. It fails to adapt the practical conditions that exist in the real time environment. In the real time environment negotiation is based on the socio economic conditions. This socio economic condition adaptation enables the people to become successful in their business environment. An even person thinks about the win-win situation of adopting the condition overall profitability and long term business strategy and other customer relation maintenance are considered. Similarly in the present design an attempt made to simulate the automated negotiation strategy in adopting the socio economic cyber psycho knowledge business conditions for negotiation.

In this paper an attempt has been made to adapt all these socio-economic psycho knowledge for negotiation. As per the negotiation scenario model is concerned it uses a multi-attribute one-to-many negotiation strategy. Also, it already proved that the face-to-face negotiation [9] was not different than e-negotiation, in terms of the final price. However, both the negotiation media and the negotiation sequence significantly affected the main features of the negotiation process, in terms of time duration and the use of hard or soft tactics. Incorporation of cyber psycho enables us to adapt these tactics.

This paper is organized as follows. The section 2 explains the negotiation as a distributed constraint satisfaction problem. Section 3 explains the one-to-many negotiation mechanism. Section 4 explains the impact of socio economic psycho knowledge. Section 5 gives simple prototype implementation of one-to-many negotiation for purchasing a camcorder. Section 6 concludes this paper.

2 Negotiation as Distributed Constraint Satisfaction with the Adaptation of Socio Economic Psycho Knowledge

Negotiation is a dialogue intended to resolve disputes, to produce an agreement upon courses of action, to bargain for individual or collective advantage, or to craft outcomes to satisfy various interests. It is the primary method of alternative dispute

resolution to reach a consensus. Effective negotiation helps you to resolve situations where what you want is in conflict with what someone else wants. The aim of win-win negotiation is to find a solution that is acceptable to both parties, and leaves both parties feeling that they've won, in some way, after the event. In general, negotiation can be classified according to the number of parties involved and the number of attributes negotiated. In terms of the parties involved, negotiation scenarios can be one-to-one, one-to-many or many-to-many. In terms of negotiation attributes, a negotiation can involve a single attribute (eg. Prize) or multiple attributes (eg. Prize, quality and delivery time). In this attempt intelligent trading Agency supports multi-attribute, one-to-many negotiation and incorporate the cyber psycho-economic knowledge.

2.1 Cyber Psychos-Economic Knowledge Based Seller and Buyer Agents

Incorporation of cyber psycho economic knowledge is through the buyer and seller agent. As per the seller is concerned it must collect the following knowledge about the buyer agent. This information are buyer group information, customer economic status, product margin, product movement index and overall profitability. Virtual communities [10] represent an effective way for facilitating the circulation of knowledge in organization and groups. Particularly, this approach relies on using cognitive agent informed of social cognition theories that are able 1. to infer the individual participatory profile of the members from the observation of their online behavior 2. To use these profiles and the participatory principles to determine individual interventions that are the more likely to impact people participation 3. To intervene proactively.

1. Buyer (Customer) Group information. As like above, in this case we classify the different types of customers (Buying Agents). Such as Regular customer, new customer based on their history. If customer agent is regular then Ti is assumed to be 1, otherwise it is 0.5.

2. Customer economic status. In another method, different economic states are identified. Based on this, the Standard Customer, Non-standard Customer and Bulk Customer are identified. The Standard customer is that customer who will not bargain much on prize. They will bargain only for other attributes. The bulk customer is a customer who buys a huge set of products in one or two instances. These two above attributes are considered for negotiation. If customer agent is standard customer/bulk customer then Ei is assumed to be 1, otherwise it is 0.5.

3. Margin. This attributes indicates the maximum margin prize that can be offered to the customer. It is also one of the important attributes considered for negotiation. If seller margin is above 20% then Mi is assumed to be 1, otherwise it is 0.5.

4. Product movement index and future sales ratio. An expert marketing professional maintain a Product Movement Index (PMI). This indicates the speedy movement of the product in the market. If the market is good then the index will be high. Some time the high discount offer is given to the low Product Movement Index Products. If PMI is good then PMIi is assumed to be 1, otherwise it is 0.5.

5. Over all profitability. Over all products set profitability is taken for the complete set of the product. Sometime the high offer can be given to the last few products without loosing the overall profitability of the product set. If the overall profitability is good then Pi =1, otherwise it is assumed to be 0.5.

Table 1. Customer Profile

Customer Id	**#00078**
Regular Customer	Yes
Standard Customer	No

Table 2. Product Profile

Product Id	**#0089**
Product Margin	30%
PMI	High
Overall Profitability	High

2.2 Offer Evaluation

While considering these additional attributes of socio-economic psycho knowledge, the customer will be treated differently. They will be given different offers based upon the socio-economic psycho status. Even though these attributes are considered, the main objective is to increase overall profitability of both sides. ITA agents use multi-attribute utility theory and constraint-based reasoning [11] for the evaluation and generation of offers and counteroffers. Let us start with offer evaluation. For an offer received by agent A from agent B to be considered, it has to satisfy all constraints, that is, the proposed value of each variable must belong to its domain as specified by agent A. Then, the value of an offer consisting of a number of attributes X = {x1,x2,……xn} is defined as a function.

$$v(x_1,x_2,\ldots\ldots x_n) = \sum_{i=1\ldots n} w_i v_i(x_i) \,/\, \sum_{i=1\ldots n} w_i = c_i \qquad (1)$$

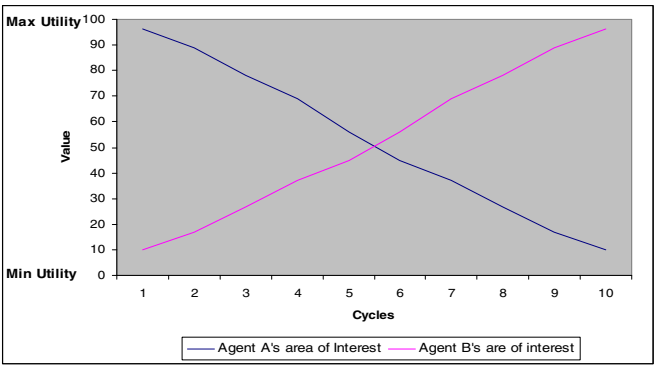

Fig. 1. Constraint-Based Model of One-to-One Negotiation

Where xi is i^{th} attribute of negotiation, vi is the utility function of the ith attribute and w_i is the weight (priority) of the value of the ith attribute. c_i is the socio-economic psycho weight of the ith customer's. The utility function is used for comparing and ordering alternative acceptable solutions.

Fig. 1 shows that the acceptable offer by both agents is one which satisfies at least the minimum utilities of both agents. If the line meets at a particular point, a solution can be found, otherwise the negotiation fails. An agent can see the minimum boundary as a constraint on the domain of acceptable total utility values.

2.3 Offer Generation

In this case of ITA both agents generate the offers and counter offers by adapting different strategies. Different agent negotiation strategies are as follows

i. If the customer is the standard customer no offer is given to him, otherwise if he is the non-standard customer then the offer is given to him in a step by step. If the customer is the bulk customer then the offer is specially given to him.
ii. If the customer is the regular customer then the offer is given to him otherwise no special offer is given to him.
iii. If the product movement index is good and the margin is good then the offers is given to him, otherwise no offer is given.
iv. The overall profit margin is good then the offer is given, Otherwise no offer is given to the customer.

The overall socio-economic psycho weight

$$c_{i\,(1,2,\ldots\ldots n)} = 1 - T_i E_i M_i P_i PMI_i(y) \tag{2}$$

Table 3. Customer Personality Type Classification

S. No.	Personality Type	Basic Attitude	Ti
1.	Psychopathic (antisocial)	Don't want to purchase anything	0.1
2.	Depressive and manic (impulsive)	Unpredictable Customer with less possibility	0.2
3.	Hysterical (histrionic)	Unpredictable Customer reasonable possibility	0.3
4.	Dissociative	Unpredictable Customer high possibility	0.4
5.	Masochistic (self-defeating)	Based on the attractive Advertisement he will buy the product	0.5
6.	Schizoid	Want to purchase things with high profitability	0.6
7.	Narcissistic	Want to purchase things with reasonable profitability	0.7
8.	Paranoid	Somehow he want to purchase	0.8
9.	Obsessive and compulsive	Somehow without considering the cost he/she will buy the product	1.0

The socio-economic psycho weight,c_i for product y at i^{th} offer is the combined parameter of Ti Ei Mi Pi PMIi, where Ti indicates the user type, Ei indicates the economic status, Mi indicates the margin, Pi indicates the overall profitability and PMIi is the product movement index. The customers are classified in to different types based on their personality type and is given in the following Table 3. So, the offer is given based on all these combined parameters.

If agents want to lead effectively, agent needs to be able to make good decisions. If agents can learn to do this in a timely and well-considered way, then the agent can

lead best team to spectacular and well-deserved success. However, if agent dither or make poor decisions, your team risks failure and agent time as a leader will probably be brutally short. The techniques in this section help the agent to make the best decisions possible with the available information agents have. They help agents map out the likely consequences of decisions, work out the importance of individual factors, and choose the best courses of action.

3 One-to-Many Negotiation Mechanism

In this present approach to automate one-to-many negotiations, the Iyad Rahwan's [6] approach is adapted in order to test the impact socio-economic psycho knowledge incorporation. The main advantage of this approach it is possible to scale to many-to-may negotiation.

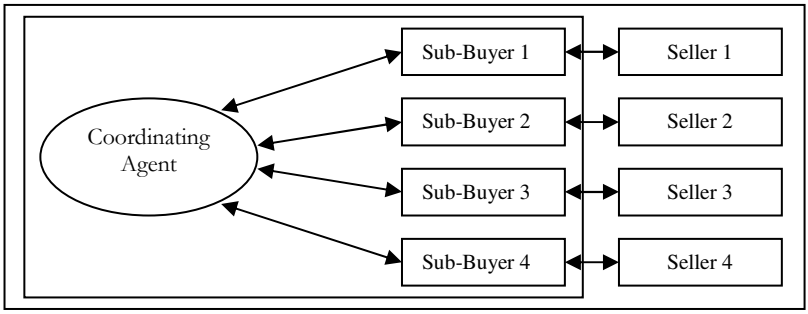

Fig. 2. One-to-Many negotiation (One buyer & many sellers)

We now present our approach to automating one-to-many negotiations. The scenario we are tackling is one in which one agent (buyer or seller) wants to negotiate a deal with a number of opponents, in order to find the best possible deal in the market. We propose reusing the techniques and components we used in one-to-one negotiations. This offers an advantage over approaches in which one single complex agent must conduct and directly maintain multiple threads of negotiation. In ITA, an agent can negotiate with many other agents by creating a number of one-to-one negotiating agents that negotiate on its behalf, and perform the task of coordinating them. We will call these agents sub-negotiators. Every sub-negotiator conducts a one-to-one negotiation with a different opponent. After each negotiation cycle (one offer and counteroffer), each sub-negotiator reports the results back to the coordinating agent. The coordinating agent then evaluates the situation, and issues instructions accordingly.

Fig. 2 shows an instance of one-to-many negotiation scenarios. In this particular scenario, a buyer agent negotiates a deal with many prospective sellers. The buyer agent consists of a coordinating agent and a number of sub-negotiators (sub-buyers). All sub-buyers represent the preferences and constraints of the same buyer, but they may use different negotiation strategies. Similarly, a single selling agent can negotiate

with a number of prospective buyers by instantiating a number of sub-sellers, and coordinating them. From an architectural point of view, our approach has many advantages over existing systems:

i. It offers simplicity and reusability by allowing us to reuse any existing one-to-one negotiating agent in a one-to-many setting, hence providing rapid development of negotiation applications.
ii. It allows for the system to be highly customizable since sub-negotiating agents can be modified, removed, or new agents with new strategies and capabilities can be added dynamically to the system at any point in time.
iii. This also allows for better scalability since not only can the different negotiation parties be on different machines over a network, but also can the different sub-negotiators of the same agent.
iv. The resulting system becomes more robust compared to a centralized complex agent. If one negotiation thread dies due to technical difficulties for example, the other threads can continue (as long as the coordinating agent is still alive).
v. In principle, it would be also possible for each sub-negotiator to be a one-to-many negotiating agent consisting of a coordinator and several sub-negotiators, and so on.

In ITA, there are two levels of negotiation strategies, namely strategies exercised by individual buyer or seller agents in their one-to-one encounters, and strategies exercised by the coordinating agents in organizing and issuing commands to their sub-negotiators. Negotiation Strategies of individual sub-negotiators include:

i. Take it or leave it (fixed offer).
ii. No concession (same level of satisfaction, but possibly different offers).
iii. Fixed concession.
iv. Better deal strategies (resuming negotiation after deal is found hoping a better deal may come).

Details of these strategies and a few experiments on them can be found in [12]. We outline a few simple coordination strategies that can be exercised by the coordinating agent for controlling sub-negotiators:

i. Desperate Strategy: This is a very simple strategy in which the time constraints may be important and the agent wants to close a deal fast. In this strategy, as soon as a sub-negotiator finds an acceptable offer, the coordinating agent accepts it and sends messages to all other sub-negotiators to terminate their negotiation. If more than one sub-negotiator comes up with an acceptable offer, the one with the highest utility is chosen while the rest are terminated.
ii. Patient Strategy: In this strategy, even if an acceptable deal is found by one or more sub-negotiator(s), those agents are asked to wait while all other agents are asked to resume their negotiations. Once all sub-negotiators complete their negotiation process (whether with success or failure), the best offer is chosen. This strategy guarantees that the best possible deal can be reached, but does not give regard to time constraints. This might be a significant limitation in a marketplace with too many potential suppliers to negotiate with. One variation of the patient

strategy is one in which a time limit is set by the user, within which if no better deal is found, the negotiation terminates and the best deal so far wins.

iii. Optimized Patient Strategy: In this strategy, the coordinating agent uses information about one negotiation outcome to influence the performance of other sub-negotiators. The constraint on the utility for the other sub-negotiators is updated in order to avoid unnecessary deals which are not as good as the one already found. For example, if the accepted minimum total utility is 5, and one sub-negotiator has found a deal with utility 7, there is no point in other sub-negotiators reporting back a deal with utility 6 even though it is an acceptable deal (according to the initial constraints). In this case, the constraint on the utility for all remaining sub- negotiators is updated to be 7, causing any deal below that margin to be unacceptable. This also ensures that no sub-negotiator offers an offer that is worse than an offer received by a fellow sub-negotiator.

iv. Strategy Manipulation Strategies: In this class of strategies, the coordinating agent may modify the negotiation strategies of different sub-negotiators at runtime. For example, after securing a deal, other sub-negotiators can exercise a take-it-or-leave-it strategy with their opponents. More sophisticated use of such strategies is left for future research. In addition to the architectural advantages mentioned above, there are advantages relating to the method of representing preferences and constraints. We are using declarative knowledge representation in the form of constraints, which can be easily exchanged between, and understood by, different agents, makes adding and removing sub-negotiators and communication between them an easier task.

4 Prototype Simulation

In this section, a prototype implementation to demonstrate ITA's capabilities are tested with Java based IBM aglets [13]. An Agent Transfer Protocol (ATP) is used to communicate with these different agents. Aglet uses a technique called serialization to transmit data on the heap and to migrate the interpretable byte-code. These aglets are supporting message passing and broadcasting. Each aglet is integrated with the functional components of this architecture. The blackboard system is shown as the explicit component and is implemented through using standard java serialization.

After execution the coordinating agent is able to automatically select the sub-buyer after comparing their resultant negotiation. In this case, all the plot screens are shown in Fig. 3,4,5,6. The program is underdevelopment and so the values are taken and screen is plotted through MS-Excel. From these four sub-buyers the agent is able to

Table 4. Socio-Economic Psycho Weight C_i Matrix for Sample Scenario

Sub-Agent No. (i)	Ti	Ei	Mi	Pi	PMIi
1	0.5	1	0.5	1	1
2	0.5	1	1	1	1
3	1	1	1	1	1
4	0.5	1	0.5	1	0.5

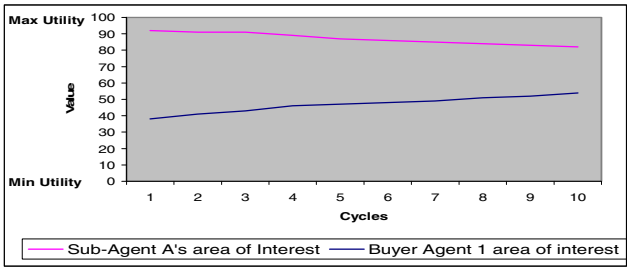

Fig. 3. Negotiation Result for Sub Agent A

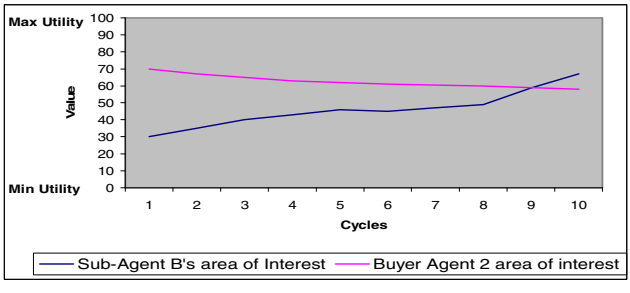

Fig. 4. Negotiation Result for Sub Agent B

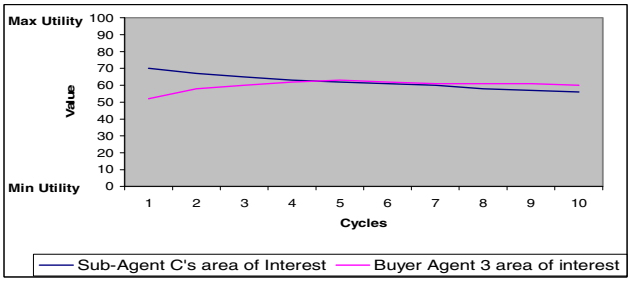

Fig. 5. Negotiation Result for Sub Agent C

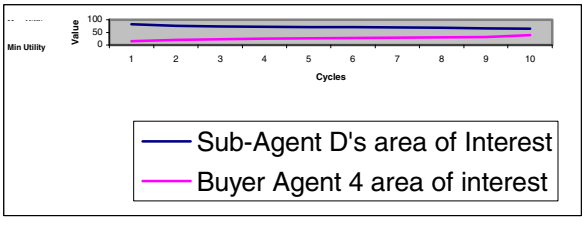

Fig. 6. Negotiation Result for Sub Agent D

select third sub-buyer. It gives the best cost profit after negotiation. Even though Sub-Agent B and Sub-Agent C are reaching a solution, Sub-Agent C is always chosen, because Sub-Agent C is having good Socio-Economic Psycho Weight.

5 Conclusion

This paper presents an intelligent trading agency (ITA) to support fully autonomous multi-attribute negotiations in the presence of socio economic psycho knowledge. It is shown that incorporation of socio economic psycho knowledge enables the system to give better profit for both the buyer and seller. The multi-agent based one-to-many negotiation is proved to be customer adaptive, business adaptive and automated. The results are compared with the regular constrains, preferences, criteria and socio economic psycho knowledge implementation. One individual agent will be able to negotiate multi-issue by exchanging offers and counter offers until they either reach a consensus that satisfies each party's private preferences and constraints, in adopting socio economic conditions, or they run out of offers and the negotiation fails. The system is implemented using the Aglet and a pilot application that uses a Camcorder trading scenario.

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