Adaptive Negotiation Agent System for E-Commerce Applications

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Abstract - The main purpose of this work is to conceive, design, implementation, and evaluate different models of negotiation between autonomous agents, built to assist the users in automated negotiation for e-commerce. The negotiation process is a complex feature of traditional buying and selling. This process can be examined in the context of automated negotiation, as applied in the agent based e-commerce system. The negotiation process is improved using learning algorithms. The use of learning techniques is investigated, in order to allow agents to reuse their negotiation experience for improving the final outcomes. The learning mechanism is used to improve the agent strategies in negotiation. Experimental results on four real world specific scenarios evaluate the performances of the agent system for automated negotiation The main goal of this research is to develop a set of adaptive negotiation strategies, a model of autonomous entities that use these strategies and an associated implementation based on agent system technology.

I. INTRODUCTION

Automated negotiation is achieving steadily growing attention as a mechanism for coordinating interaction among computational autonomous agents which are in a consumer-provider or buyer-seller relationship and thus typically have different interests over possible joint agreements.The thesis realizes the modeling and design of Adaptive Negotiation Agent System For E- Commerce Application, in which every agent has a cognitive part, composed from a knowledge base and an inference engine. The agents negotiate, based on a negotiation language, which contains a set of primitives, and also based on negotiation criteria, represented as rules. The negotiation process is a complex feature of traditional buying and selling. This process can be examined in the context of automated negotiation, as applied in the multi-agent based e-commerce. Real-world negotiations do not require the parties to reach a negotiated agreement; similarly, the automated negotiation covered here has the same option. An agent can choose no deal if it cannot negotiate a satisfactory agreement. Furthermore, we distinguish between “open” and “closed” marketplaces. A closed marketplace is based upon a predefined set of users, who “enroll” in the marketplace and agree to a certain set of rules. An open marketplace has no such agreement; agents are welcome to enter and exit at any time, and are required to agree to no rules.

The Need for Negotiation in e-Commerce

Negotiation in electronic commerce is the process in which two or more parties multilaterally bargain goods or services for mutual intended gain, using the tools and techniques of electronic commerce [Beam C. and Segev A., 1997]. Automated negotiations take place when the negotiating function is performed by software agents.

A software agent is a computer program that acts for a user or other program. It represents an entity with goals, capable of actions endowed with domain knowledge and situated in an environment. Multi-agent systems are distributed agents that do not have the capabilities to achieve a goal alone and should communicate for this. They are suitable for the domains that involve interactions between different people or organizations with different goals.

Argumentation-based approaches attempt to overcome the limitations of other approaches, by allowing agents to exchange additional information, or to argue about their beliefs and other mental attitudes during the negotiation process. In the context of negotiation, an argument is a piece of information that may allow an agent to justify its negotiation position or to influence another agent’s negotiation position [Rahwan I. et al., 2003].

Effective and efficient multi-issue negotiation requires an agent to have some indication of its opponent’s preferences. However, in competitive domains, such as ecommerce, an agent will not reveal this information and so the best that can be achieved is to learn some approximation of it through the negotiation exchanges [Coehoorn R. and Jennings N., 2004].[1]

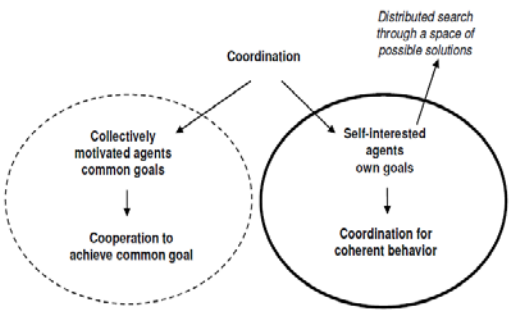

Figure 1: Coordination in Negotiation [Florea A.M., 2012]

II. LITERATURE REVIEW

Literature review: I am go through various research paper for literature review and till now I am taking some paper as base paper for my research, that are:

DEVELOPING A MULTI-AGENT

Traditionally, e-negotiation processes have been carried out by humans registering themselves at certain web pages, placing bids and making offers through fill-in forms, and receiving counter-offers of other participants by updating the respective web pages. One major drawback of this human-centered way of e-negotiation is that the underlying processes are not explicitly modeled and the knowledge and experience are kept within the human minds. The next step towards automated e-negotiation systems is to be achieved through software agents that act as automated participants in the e-marketplace. Automated negotiation is an important research area of e-commerce negotiation after the negotiation support system (NSS). It is the direction of development for the e-commerce automated trade. Its main principle is using software agent technology to make the process of negotiation to be part or full automation. The purpose is improving the efficiency of online negotiations and reducing costs of trade. Since the mid-90's last century, the research on automated negotiation system has been given high priority by researchers.

At present, one severe problem for the research of automated negotiation is how to take the theoretical results into practical applications. For more than ten years, compared with the fruitful results of theoretical research, the application of automated negotiation systems has lagged far behind. So far, there is scarcely any practical automated negotiation system that can be applied in e-commerce . The realization of system remains at experimental stage as most prototype systems were developed in university.

laboratories and automated negotiation technology is still under investigation in research labs. It could take some time before practical B2B e-commerce systems to adopt a negotiation tool . That has been a barrier for the research of automated negotiation. The fact that many good theories, models and algorithms cannot be verified without a practical application platform constrains the further development of automated negotiation research.

Agent-based Electronic Markets for Project Supply Chain Coordination

The key opportunity for project supply chain coordination is the emergence of the Internet and the World-Wide-Web (WWW). As the WWW evolves and expands to include more business-to-business transactions, information sharing and the level of integration of activities between the supply-chain partners will increase. This new complexity necessitates new approaches to decision-support and information management in order to build highly flexible, fast, secure, and reliable systems that can allow subcontractors to take advantage of the new opportunities.

Software agents are atomic software entities operating on behalf of humans or machines (Moses

1999); software agent technology has been used to automate several of the most time-consuming tasks on many occasions (Maes, Guttman, and Moukas 1999).

We envision that software agents can help subcontractors utilize web-based supply chain coordination. Through our proposed research, the functionality of the project supply chain coordination will be transformed to constructing a virtual supply chain in a multi-agent system through the negotiation process among software agents. The currently developing multi-agent system will allow software assistant agents to evaluate the impact of their changes and advise the human subcontractors. Another functionality resulting from the dynamic nature of project supply chain coordination will be added for the new multi-agent system for project supply chain coordination.

COLLECTIVE BARGAINING NEGOTIATIONS

Collective bargaining is specifically an industrial relations mechanism or tool, and is an aspect of negotiation, applicable to the employment relationship. As a process, the two are in essence the same, and the principles applicable to negotiations are relevant to collective bargaining as well. However, some differences need to be noted.

In collective bargaining the union always has a collective interest since the negotiations are for the benefit of several employees. Where collective bargaining is not for one employer but for several, collective interests become a feature for both parties to the bargaining process. In negotiations in non-employment situations, collective interests are less, or non-existent, except when states negotiate with each other. Further, in labour relations, negotiations involve the public interest such as where where negotiations are on wages which can impact on prices. This is implicitly recognized when a party or the parties seek the support of the public, especially where negotiations have failed and work disruptions follow. Governments intervene when necessary in collective bargaining because the negotiations are of interest to those beyond the parties themselves.

In collective bargaining certain essential conditions need to be satisfied, such as the existence of the freedom of association and a labour law system. Further, since the beneficiaries of collective bargaining are in daily contact with each other, negotiations take place in the background of a continuing relationship which ultimately motivates the parties to resolve the specific issues. The nature of the relationship between the parties in collective bargaining distinguishes the negotiations from normal commercial negotiations in which the buyer may be in a stronger position as he could take his business elsewhere. In the employment relationship the employer is, in a sense, a buyer of services and the employee the seller, and the latter may have the more potent sanction in the form of trade union action.

Unfortunately the term "bargaining" implies that the process is one of haggling, which is more appropriate to one-time relationships such as a one-time purchaser or a claimant to damages. While collective bargaining may take the form of haggling, ideally it should involve adjusting the respective positions of the parties in a way that is satisfactory to all, for reasons explained in the Paper entitled "Principles of Negotiation".

Rule-Based Automated Price Negotiation: an Overview and an Experiment

A formal executable approach for defining strategy of agents participating in negotiations using defeasible logic programs is reported . This approach was demonstrated using English auctions and bargaining with multiple parties by indicating sets of rules for describing strategies of participating agents. However, no implementation results were reported. It is also interesting to note that despite the fact that paper claims to address both protocol and strategy representation in defeasible logic, finally only a simplistic example of a protocol for two bidding rounds auction is described, while more detailed examples are provided only for strategy representation. In a preliminary implementation of a system of agents that negotiate using strategies expressed in defeasible logic is described. The implementation is demonstrated with a bargaining scenario involving one buyer and one seller agent. The buyer strategy is defined by a defeasible logic program. Note that the implementation reported in builds on the architecture of negotiating agents previously introduced in . CONSENSUS allows agents to negotiate di_erent complementary items on separate servers on behalf of human users. Each CONSENSUS agent uses rules partitioned into:

i) *basic rules* that determine the negotiation protocol, ii) *strategy rules* that determine the negotiation strategy and iii) *coordination rules* that determine knowledge for assuring that either all of the complementary items or none are purchased. Note that in CONSENSUS the rule-based approach is taken beyond mechanism and strategy representation to capture also coordination knowledge.

- Rule-Based Automated Price Negotiation: an Overview and an Experiment

we have set our system up for a particular negotiation scenario involving English auctions. In an

English auction there is a single item sold by a single seller and many buyers bidding against each other to buy this item. Usually, there is a time limit for ending the auction, a seller reservation price that must be met by the winning bid for the item to be sold and a minimum value of the bid increment. A new bid must be higher than the currently highest bid plus a minimal bid increment in order to be accepted. All the bids are visible to all auction participants.

The constraints describing English auctions were encoded as a modularized set of JESS rules. The rules were then used to initialize the negotiation hosts Strategies of participant agents are defined in accordance with the negotiation protocol (i.e. English auction in this particular setting). Basically, strategy defines if and when a given participant will submit a proposal and what are its parameters. For the time being we opted for a simple solution: the participant submits a first bid immediately after it is granted admission and whenever it gets a notification that another participant issued an accepted proposal. The value of the bid is equal with the sum of the currently highest bid and an increment value that is private to the participant. Each participant has its own valuation of the negotiated product. If the value of the new bid exceeds this value then the proposal submission is canceled.

III. THE NEGOTIATION MECHANISM

Designing a negotiation mechanism means defining a negotiation protocol and a negotiation strategy for the agents in the system. The choice of the negotiation protocol in conjunction with the negotiation strategies adopted by the agents determines the type of outcome that is produced by the mechanism. A protocol used for bilateral negotiations is the monotonic concession protocol [Rosenschein J.S. and Zlotkin G., 1994][7] . A buyer agent can negotiate over multiple issues in parallel and, for each issue, the agent concurrently negotiates with its trading partners. If the buyer doesn’t know how to set the price of each of the issues, one approach is to negotiate over all the issues in parallel [An B. et al., 2010]. For each issue, there are multiple trading partners and the agent concurrently negotiates with all of them. Generally, a buyer obtains

more desirable negotiation outcomes, when it negotiates concurrently with all the sellers in competitive situations, in which there is information uncertainty and there is a deadline for the negotiation to complete. Inefficiency may arise in sequential negotiation, when considering the overall time cost to complete all the necessary negotiations [Fatima S.S. et al., 2006]. As agents can choose to decommit from agreements, negotiation consists of a bargaining stage and a DE commitment step for each negotiation thread. A pair of buyer and seller agents negotiates by making proposals to each other. At each round, one agent makes a proposal. Many buyer-seller pairs can bargain simultaneously, since each pair is in a negotiation thread. If the seller accepts the proposal of the buyer, negotiation terminates with a tentative agreement. If the seller rejects the proposal of the buyer, negotiation terminates with no agreement. If the seller makes a counterproposal, bargaining proceeds to another round and the buyer can accept the proposal, reject the proposal, or make a counterproposal. Bargaining between two agents terminates: when an agreement is reached or with a conflict (no agreement is made), when one of the two agents' deadline is reached or one agent quits the negotiation. After a tentative agreement is made, an agent has the opportunity to decommit from the agreement and it pays the penalty to the other party involved in the decommited agreement [Sandholm T. and Lesser V., 2001].

Shops and clients are created through a GUI interface that links users (buyers and sellers) with their Personal Agents. However, these agents are in many ways spurious for the operation of the system. More precisely, a Personal Agent is considered to be a true representative of the user that resides on her machine and represents her interests in all aspects of e-life.

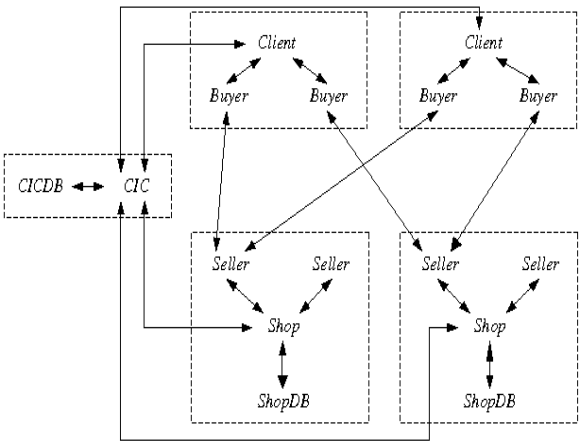

Figure 2- The conceptual architecture of our e-commerce environment (two-client; two-store version).

A Client agent (CA) is created by the Personal agent to act within the marketplace on behalf of a user that attempts at buying something. Similarly, a Shop agent represents user who plans to sell something within the e-marketplace. After being created both Shop and Client agents register with the CIC agent to be able to operate within the marketplace. Returning agents will receive their existing IDs. In this way we provide support for the future goal of agent behavior adaptability. Here, agents in the system are able to recognize status of their counterparts and differentiate their behavior depending if this is a "returning" or a "new" agent that they interact with.

There is only one Client Information Center (CIC) agent in the system. It is responsible for storing, managing and providing information about all "participants" existing in the system. To be able to participate in the marketplace all Shop and Client agents must register with the CIC agent, which stores information in the Client Information Database (CI- CDB). The CICDB combines the function of client registry, by storing information about and unique IDs for all users and of yellow pages, by storing information about of all shops known in the marketplace. Thus Client agents (new and returning) communicate with the CIC agent to find out which stores are available in the system at any given time. In this way we are (i) following the general philosophy of agent system development, where each function is embodied in an agent and (ii) utilizing the publisher-subscriber mechanism based on distributed object oriented systems. Furthermore, this approach provides us with a simple mechanism of correctly handling the concurrent accesses to a shared repository without having to deal with typical problems of mutual exclusion etc. Actually, all these problems are automatically handled by JADE's agent communication service.

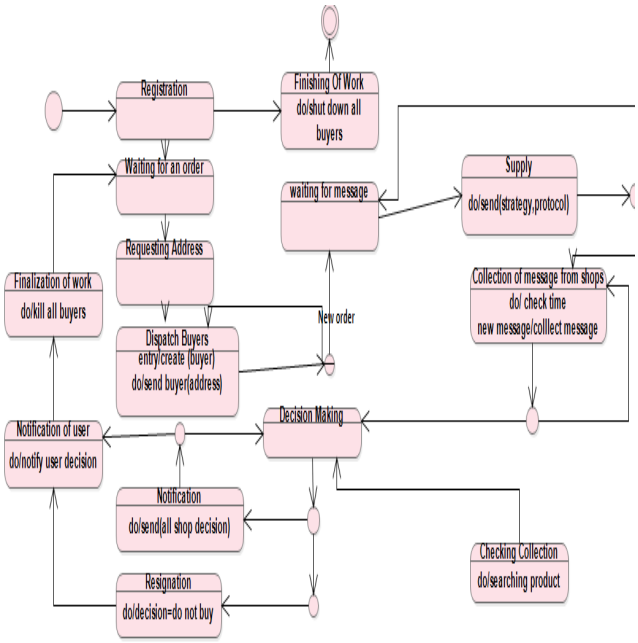

Fig 3: UML state chart diagram of the Client agent.

A Client agent is created for each customer that is using the system. Each Client agent creates an appropriate number of ”slave” negotiation agents with the ”buyer role” (Buyer agents hereafter).

Seller agents await incoming Buyer agents interested in buying their products and upon their arrival engage in negotiations with them (see Figure). Let us now describe what happens in the marketplace after a customer has made a purchase request, until a request is completed.

1. As specified above, a Client agent registers with the CIC agent. It obtains a new ID if it is a new Client or recovers its original ID if it is a returning Client. The information that an agent with a given ID is active in the marketplace is stored in the CICDB database (this step involves interactions between the CIC agent and the CICDB agent).

2. The Client agent queries the CIC agent to obtain the list of Shop agents selling the product it is expected to purchase. For each Shop agent on this list it creates a Buyer agent to negotiate conditions of purchase.

3. Buyer agents migrate to Shop agent sites and query Shop agents about the negotiation protocol used in a given e-store and which Seller agent they should negotiate with. Then, Buyer agents dynamically load appropriate negotiation from Client agents and subscribe to the designated Seller agent, waiting for the negotiation process to start.

Message Agent

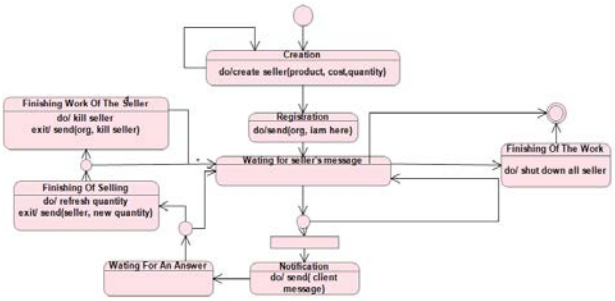

Fig 3: UML statechart diagram of the Shop agent.

Shop agents that will be a part of the e-marketplace; and therefore the GUI and Personal agents are omitted from further considerations. The top level conceptual architecture of the system illustrating proposed types of agents and their interactions in a particular configuration is shown in Figure . Let us now describe each agent appearing in that figure and their respective functionalities.

Message Agent: Message Agent focus on client agent .Its monitor all the activities of client agent means how many time client interact with application , the scale of purchasing , monitor the products which are mostly visited by client.

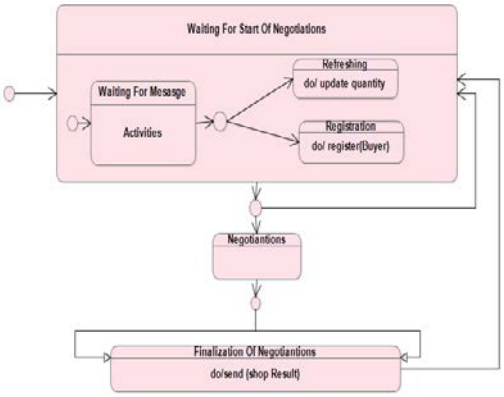

Fig 4: UML statechart diagram of the Seller agent.

If client agent is tempary (client which interact application after the certain interval) , then Message Agent only provide the information about those products which consist offer.

If client agent is regular (client which interact with application time to time), then the message agent generate the special offer for client.

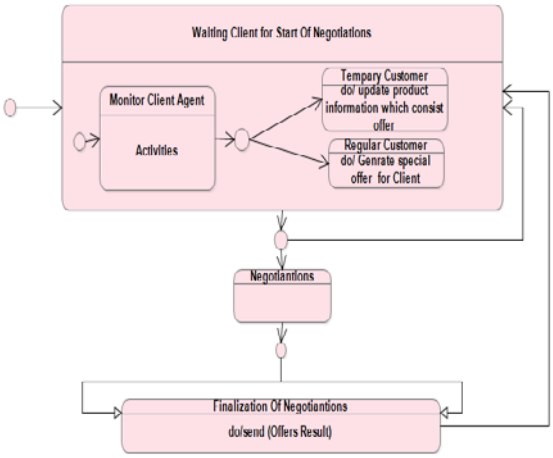

Fig 5: UML statechart diagram of the Message agent.

IV. CONCLUSION

The automated negotiation has economical outcomes, because it has lower transaction costs, enabling higher volumes and new types of transactions in the electronic business domain. Through its automation, the negotiation mechanism becomes available to autonomous systems, improving the performance of these systems, when negotiation is used for agent coordination and cooperation, instead of existing interaction mechanisms.

The agents’ behavior can change during negotiation, according to previous interactions with other agents in the

system. Changing behavior may refer to either the use of different negotiation strategies or to concessions made for other agents, with which they have successfully negotiated in the past. To this aim, an agent develops a set of profiles during negotiation: the preference profile, the partner cooperation profile, and the group-of-partners' negotiation profile. The first two profiles characterize individuals, while in a group negotiation profile, several agent profiles are clustered, according to commonly discovered features. The automated negotiation mechanism facilitates the self-interested agents to make decisions, which give them the optimal outcome.

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