Research on Negotiation Agent for E-commerce Systems

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Abstract— **Nowadays electronic markets are evolving in such a way that, they could provide various products and services automatically over Internet. Even though ample of services are made available through the Internet with the use of E-commerce, but the basic need of providing products and services that actually benefits the customer remains as it is. Dealers provide with a lot of deals, offers, coupons over the sites such as ebay.com, amazon.com, etc., but there is less or no input taken from the customers about their terms and conditions for a product during the purchase. So negotiation is a service that mutually reaches an agreement which is beneficial for both parties by considering multiple issues (price, quality, warranty, delivery time, etc.) of a product. Where one party can bargain by making offers to the opponent party, evaluating the offers by the opponent and making counter offers by following different strategies and protocol for negotiation. This negotiation service resembles the real world activity of bargaining. The paper suggests different methods of achieving the negotiation service on E-commerce sites. And the proposed ANFIS-based model for negotiation is compared with previously discussed Pareto Optimal technique and Multi-Strategy Selection Model. The flow of model with the evaluation parameters to show the impact of each of three models is suggested.**

Keywords— Bilateral negotiaiton; startegies; Pareto optimal technique; multi-strategy; multiple-issues; machine learning; ANFIS

I. INTRODUCTION

The process of making conflicting, as well as convincing statements by the parties in their communication at the time of product purchase, is called negotiation. Making this process online through e-markets is done by a negotiation agent (NA). NA has a major role in creating Intelligent Negotiation Automated System for electronic markets. Currently, the intelligent agents are used for following reasons:

- Retrieving Information: Searching for the contents of the web usually documents from the large collection of resources.

- Predicting: Putting forth some results that are thought to happen, from the content examined.

- Recommending: Advising something that is related or of interest.

Over e-markets such methods could be used for searching a product, comparing product prices, knowing customer interest and suggesting product and services information to the consumer. The intelligent agent makes the negotiation process autonomous that precipitate to save human labor. Key components of negotiation agent to make negotiation autonomous are private data, knowledge base and rule base.

The private data like the reservation value for buyer and the seller i.e. the maximum and minimum values set by each to buy and sell the product. The knowledge base consists of past data and initial values of the product. The rule base consists of decision statements that capture the human negotiating behavior in the form of rules which are used to fire the output based on given input to the negotiation model.

In general, we define negotiation process as an iterative process, where at the end of negotiation the results generated should benefit both parties. During negotiation both the parties i.e. buyer and seller act selfish so that they can maximize their utility where a buyer is willing to buy the product at the lowest possible price and the seller wants to sell the product at the highest possible price [7]. The problem with existing system [2] is that any further queries or inquiries by the buyer for a product, has to be made through a contact link or make a call to resolve some issues about the product, some cultural constraints where human consideration is required makes negotiation process time-consuming. And all the information regarding the product is provided by the seller to make a purchase. Thus by replacing the information source by both buyer and seller could gain profit and purchase satisfaction individually on some terms or collectively on some issue.

Imitating human behavior is difficult to implement because of its unrealistic behavior, to cope with human behavior strategies and protocols can be used to carry out negotiation. Negotiation strategies are nothing but the decision-making models entertained by the parties involved in the negotiation. These strategies are also called tactics which are the set of functions that determine how to compute the value of an issue (price, warranty, delivery time, etc.) by considering a single criterion (time, resource, etc.) [5]. Negotiation protocols define the rules that govern the negotiation taking place. The model proposed in [1], is a multi-strategy selection model, which works on Faratin's time-dependent concession model that represents a concession curve that can be varied and shape of each curve represents human negotiation behavior.

To work with multiple issues Pareto Optimal technique [3] is being proposed which can mainly be implemented for bilateral negotiations. It's a multi-criteria decision-making technique and can be used in e-commerce negotiation for selecting issues that are highly relevant for bargaining. MGT algorithm [3] generates offers and counter offers for issues that are selected by the seller and buyer while negotiating. Also, the information (i.e. the importance of an issue to each party) about the opponent is gained which can be useful in selecting proper issue and make a counter offer during negotiation. The model can adopt learning mechanism to make future decisions when the strategies of agents evolve through repeated interactions.

Various learning algorithms [10] are ID3, Reinforcement learning, Q-learning, and learning classifier system which could be incorporated in Pareto Optimal technique. In this research, negotiation system is enhanced with tactics and a learning algorithm is used to improve the final outcome.

Adaptive Neuro-Fuzzy Inference System(ANFIS) [13] is the best method for developing a system with learning capability. The approach here is to make the negotiating autonomous agent capable of capturing human behavior and making a purchase decision accordingly. Usually, the negotiation system is enhanced with tactics and learning algorithms are applied to improve the final outcome. Whereas ANFIS follows supervised learning and determines the final outcome by comparing the actual outcome with the desired outcome.

This paper is arranged as follows: Section II involves Background and Related work which includes the survey of related systems and work proposed by various authors. Section III consists of proposed work which contains the flow of entire negotiation model. And Section IV is Conclusion and Future Work.

II. BACKGROUND AND RELATED WORK

Current e-commerce is a high-end trend with the intent of wide spreading in the future. Today e-commerce systems like ebay.com, allows users to surf through products, choose the relevant product and make a purchase through online banking or credit card. Hence, implementing autonomous software and agents can bring the major positive change in these e-commerce systems, where purchasing process (B2C) and online transaction process (B2B) can be automated. Also, various automated systems are integrated into e-commerce system like recommender systems. Developing an e-commerce negotiation system can help sellers search for relevant consumers based on consumer activities also buyer can specify their needs regarding the product purchase. The negotiation process can achieve based on two approaches: [5]

- Alternating offer protocol: Makes a number of rounds of offers between buyer and seller with no prior knowledge or rules. The static outcome is generated as shown in Fig.1. The seller initiates the negotiation by putting forth its offer upon which the buyer has to make a decision of whether to accept/reject the offer. If buyer rejects, then he makes a counteroffer. Then seller decides to accept/reject the buyer's counter offer. And makes next offer if seller rejects the offer. This process continues until an agreement is reached. Decision-making is done by following some steps of the mathematical expression or a model.
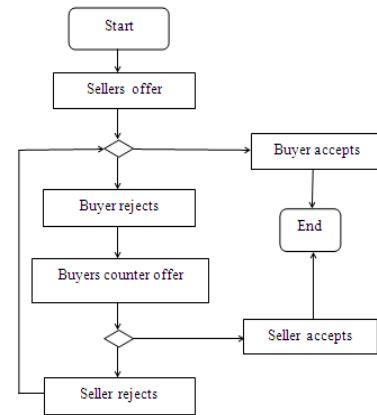

Fig. 1. Alternating offer protocol.

- Rule-based approach: Uses rules stored in an internal knowledge base of the agent that captures the human behavior. The offers over an issue to bargain for a product are made using decision-making statements to establish the best way to retrieve outcome during negotiation. The decision-making statements can be implemented using Artificial Intelligence techniques.

Game Theory and Artificial Intelligence are the two major areas which make negotiation automated. In Game Theory [11], various iteration of negotiation is being carried out, and at each iteration, an offer is made to which the opponent has to accept or reject the offer or make a counter offer. Strategies are being followed to make offers and counter offers. In Artificial Intelligence [9], the software agents act on behalf of buyer or seller during negotiation. Software agent makes use of various technologies that help the user make a better decision when buying or selling over e-commerce system.

In [7] negotiation model for negotiating over a product from buyer's side in electronic market place is mentioned. The fuzzy logic approach is used for making decisions. It enhances the interaction between buyer and seller and is efficient reasoning mechanism. In [5] a weighted combination of outcomes of various strategies is obtained to make a counteroffer. Whereas [12] presents a trade-off strategy where buyer and seller compete over the issues as paying a higher price to achieve fast delivery or waiting longer to achieve good service. It uses the heuristic hill climbing technique to explore such kind of trade-offs. In [5] the decision functions to run a negotiation agent automatically are mentioned. The negotiation model with strategies and tactics that can be used by parties for negotiation is described. These strategies are required to tackle with different situations.

In [6] the Particle Swarm Optimization (PSO) technique is used to carry out concurrent negotiations. The focus is on the buyer side. Initially, the buyer has a number of seller threads associated with him. Each thread uses PSO technique and follows some strategy to reach a mutually acceptable agreement. In [8] the bilateral multi-issue negotiation is being carried out. The method presented follows the Game Theory where each issue is considered as a pie of size 1 and the issues are indivisible. Due to multiple issues, it is possible to make trade-offs as given in [12]. The multi-strategy selection model proposed in [1] is based on Faratin's time-dependent concession model [1]. This model includes the time dependent

tactic by considering Boulware and Conceder functions for issues of each agent.

It is preferred that both the negotiation parties should reach an optimal agreement, where Pareto Optimal technique [3] is best suited. This technique involves multiple issues to be considered for negotiation. Pareto Optimal can also work with incomplete information about the opponent based on alternating offer protocol. This technique with respect to the single issue has an advantage: If one issue is the point of negotiation, then the amount of loss for one party is same as the amount gained by the opponent. Whereas in the case of multiple-issues weight is being assigned to every issue to determine its importance for the party, so profit or loss is not based on one issue as an area of interest for both parties could be different. The MGT (Maximum Greedy Trade-off) algorithm [4] is used to generate offers, and at the initial round of negotiation $O(n)$ time is required to generate offer whereas $O(n \log n)$ for next iterations.

In [13], the aim of developing a customer-centric product i.e. product that satisfies the customer is being proposed. A PSO-based ANFIS approach to model customer satisfaction is described. Where the proposed model was proved to be better than models based on fuzzy regression, ANFIS and GA-based ANFIS approach in terms of error generated.

Hence, ANFIS approach for developing a negotiation agent involves choosing the input parameters as issues for negotiating (e.g. Price, delivery time, etc.) than creating a structured model based on the values of input parameters. And then evaluating and testing the model.

III. PROPOSED WORK

The proposed negotiation system over e-commerce platforms mainly can be used to solve the manual negotiation problem over electronic markets. The aim here is to reduce the human labor of negotiation by implementing software agent that assist buyer and seller to make an online purchase.

As illustrated in fig.2, the process will start by giving the inputs to the system by buyer who is a user of an e-commerce site. The user inputs will then be preprocessed using a preprocessing software. One of the tool for preprocessing is WEKA [14]. WEKA tool is a collection of machine learning algorithm for data mining tasks. Another tool DataPreparator [15] assist in exploring and preparing data in various ways prior to data analysis or mining. The operators involve cleaning, missing values, scaling and several other tasks. The preprocessed data entry is given to the negotiation agent where the decision of whether to make counter offer, or accept the user's offer or quit the process is made using Strategic or Pareto Optimal technique or using Rule-based approach. And the output is to be presented to the user through a proper channel. Also the outcome is to be stored in database named Negotiation database for learning purpose to make future decisions about the user preferences. Rule base and knowledge base are the information storage areas in which the agent can store datasets, rules generated for decision making.
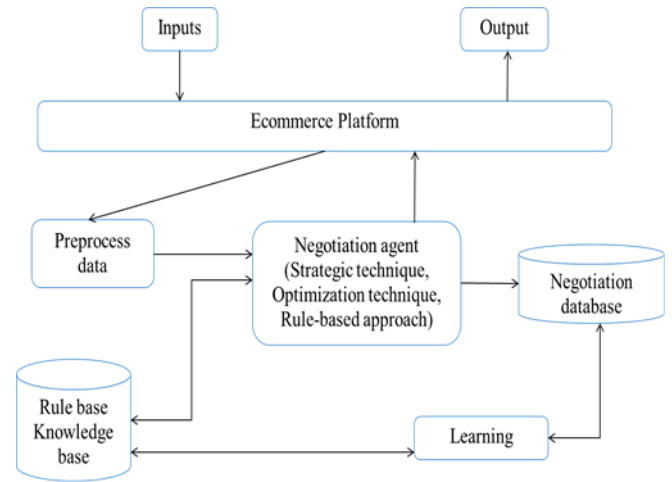

Fig. 2. Block diagram of automated negotiation system.

Learning mechanism for Strategic technique can be incorporated using Generalized regression neural network or Multilayer perception algorithm [2]. Pareto Optimal technique can be induced with algorithms [10] like ID3, Reinforcement learning, Q-learning, and learning classifier system for learning. The rule-based approach uses adaptive system which follows supervised learning.
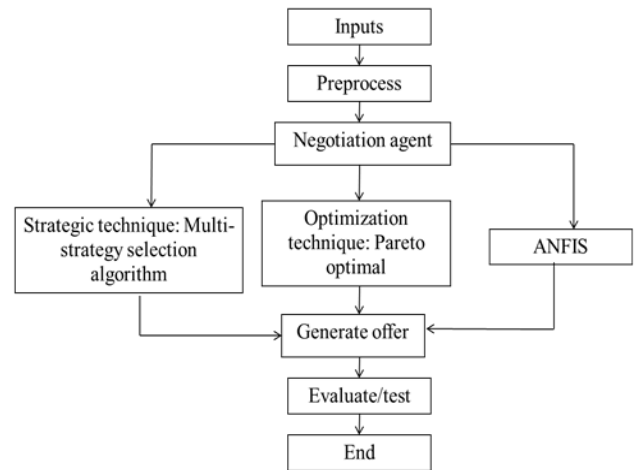

Fig. 3. The flow of negotiation process.

Fig. 3 shows the flow of the proposed block diagram from initial inputs to end. The input parameters will be price, quality, warranty, delivery time, after-sale service, return policy. Preprocessing the input data by cleaning data and analyzing for redundancy, missing values and so on to be accepted by the model. Negotiation agent accepts the inputs which consist of refined values of the parameters which generally are the offer made by opponent party. Negotiation agent has to generate the counter offer to the opponent by using one of the three techniques mentioned: strategic technique, optimization technique and rule-based approach. Multi-strategy selection model: This represents the method for strategy selection for bilateral negotiation over single attribute. But considering several attributes of a product at the same time is more important and trade off among this different attributes is necessary to get the refined outcome. Selection model can be used by buyer to change its negotiation strategy according to the seller's negotiation behavior in the process of negotiation and thus generate an offer or counteroffer. Pareto Optimal

Algorithm: Used for bilateral negotiation where agent *a* and agent *b* negotiate over *n* issues (x_1 = price, x_2 = delivery, ---, x_n = warranty) by sending and receiving offers x = (x_1, x_2, x_3, ---, xn). Each issue is considered as a slice of a pie with size 1 which is divided between a and b agents where share of agent A and share of agent B in the offers made should sum up to one. Rule-based approach: ANFIS is the best model for developing learning system. The main objective of ANFIS is to determine optimum values of fuzzy inference system parameters by applying learning algorithm using input-output data set. And optimization is done by minimizing the error between target and actual output. ANFIS train parameters using Neural networks within the context of Fuzzy Logic system. ANFIS is the learning mechanism which is to be applied for negotiation agent using alternating offer protocol. After implementation of algorithms, they are run by giving an offer to generate another offer (counter offer) for the opponent. Lastly, the evaluation of this models based on the offers generated, can be done with evaluation measures like successful negotiation rate [1], utilities of the parties involved [1], agreements considered and number of rounds required to reach that agreement. Thus, the evaluation measures evaluate the performance of each model. Ending the process by suggesting the better negotiation agent among the three best on performance analysis.

IV. CONCLUSION AND FUTURE WORK

In bilateral negotiation, two parties involved in negotiation require knowledge of the opponent. Once the knowledge is acquired the offers and counters offers are made using strategic and optimization approaches. A strategic approach is used to handle the uncertainty in knowledge and human's unrealistic behavior. While optimizations approach helps make optimized offers. The rule-based approach makes a decision based on rules stored in the internal knowledge base. This decision could be, offers over the issues between the parties.

The automated negotiation mechanism has a beneficial impact in e-commerce domain, it causes no transactional cost, data collected or used in this models can be used to enhance existing recommender systems. Automated negotiation model increases the performance of the system. The algorithms suggested are the different methods to carry negotiation. And to compare the outcomes from these algorithms based on evaluation parameters to see the effect.

The novel can be further extended to imitate the perfect behavior of human while bargaining in the real world. One way could be, recognizing the onsite behavior of customer before making a purchase. To recognize the clicks of the user on a product, description views, wish list items, etc. to make a decision whether the user is intended to purchase it and availing the offer accordingly. Also, machine learning techniques can be used to enhance the decision-making function of negotiation agent.

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