

Credibility and reputation in e-commerce

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Abstract. Since its emergence, the Internet has developed and grown almost exponentially. The markets for electronic commerce have been following almost side-by-side this growth trend, becoming increasingly common and popular among traders and occasional buyers/sellers. With this growth, the complexity and sophistication of the systems has also increased. With these developments appeared the Intelligent Agents due to their ability to finding and choosing the best deal based on the existent alternatives and restrictions. This paper proposes a model to assess the credibility and reputation of Intelligent Agents on a multi-agent e-commerce market, and to evaluate their performance on a simulator. The most important conclusion is the verification/validation that credibility and reputation mechanisms are an asset to e-commerce markets.

Keywords: Multi-Agent Systems, E-Commerce, Trust, Credibility, Reputation

1 Introduction

The commerce, as an economic activity, always had a major role in the development of the global economy. As a result of constant research and development, and to surpass itself, the e-commerce appeared, among other aspects. The concept of e-commerce arises as an attempt to achieve self-overcoming and to eliminate some of its limitations, such as: physical limitations, time limitations, etc. By eliminating these factors, we are able to maximize the deployment and proliferation of trade in the form of electronic commerce. Besides all these developments that have occurred over the years in the markets for electronic commerce, it is still difficult to ask a user to leave an electronic agent to make purchases and/or sales on their behalf. This type of business comprises two "sensitive" and "key" issues for most users: money and reputation. If a particular agent is circumvented or makes a bad deal, the user represented by this agent is considered responsible. Taking this into account, in this paper we propose a model for the assessment of credibility and reputation based on the use of a multi-agent system that when applied to a market of electronic commerce can increase the efficiency of the agents, getting a good deal and avoiding being a victim of fraud or deception on the part of another agent.

The rest of the paper is organized as follows: section 2 describes some key issues on credibility and reputation, and presents some of the existing models and approaches. Section 3 describes the proposed model and its architecture. In section 4, a set of

scenarios and experiments which allow evaluating the model are described. Some conclusions and plans for future work are described in section 5.

2 Background

Regarding the importance of having reliable and effective e-commerce systems, the credibility and reputation modelling has become a very hot topic of research. As a result, over the past years several different approaches have emerged. In this section, we will start by presenting a brief overview of the concepts related to agents credibility and reputation, then we will describe some of the existent models.

2.1 Credibility and Reputation

Several authors identified credibility and reputation, as crucial factors for establishing trust in e-commerce transactions. For instance, Sabater and Sierra in 2005 identify relations as a key issue to be used in electronic markets as a trust-enforcing, deterrent, and incentive mechanism to avoid cheaters and frauds. However, these three concepts are much interconnected and their definitions may vary with context and application area. Some authors analyse agent's credibility based on past direct interactions. This implies a significant number of previous contacts (Molm et al., 2000; Carley, 1991; Prietula, 2000; Yamagishi et al., 1998; Dasgupta, 1998). In this case, the credibility is more like a learning process. On the other side, Falcone & Castelfranchi present trust as a mental state. They argue that the following characteristics are essential to determine the value of credibility to be settled on a particular agent: competence, bias, persistence and motivation (Falcone & Castelfranchi 2001; Castelfranchi & Falcone, 2010). These characteristics influence differently the calculation of the credibility, yet they must be read together, i. e., they are inter-dependent.

2.2 Related Work

In the literature, one can find several models, which include the concepts of credibility and reputation (Pinyol and Sabater, 2011). In this section we will present Sporas Histos and Regret.

2.2.1 Sporas

Sporas (Zacharia, 1999) is a very interesting model of reputation, where the assessment of reputation is based on the ratings average, which is an advantage because it encourages players to have a correct behaviour in order to create a solid reputation.

An important aspect of Sporas is that work even with few ratings. In this model reputation varies between 0 and 3000; the newcomers are classified as a reputation of 0 and the reputation never goes below 0, even in the case of very bad behaviour.

2.2.2 Histos

This model is highly related to the phenomenon of social networks. For Histos to be effective there must be a very populated knowledge network (Zacharia, 1999). This system assumes "Pretty Good Privacy" (PGP), which states that relate social beings tend to rely more on individuals recommended by people in whom they have some confidence (Garfinkel, 1994). This principle is used to build a reliable network (Khare and Rifkin, 1997), which measures in its construction the evaluations given by each entity in the system.

2.2.3 Regret

Previous models (Histos and Sporas) based their assessments on the direct interaction and on the information given by third parties about past interactions. Regret Model reflects other aspects, i. e., it considers individual, social and ontological dimensions (Sabater & Sierra, 2002). The individual dimension is obtained by evaluating the direct interactions. The social dimension considers the relations between groups (indirect interactions, i. e. the testimony). REGRET comprises multiple factors in reputation evaluation (e.g. the ability to comply with the: seller delivery data, agreed price for the product and the required quality). Each one of these factors has its own weight in the calculation of credibility and reputation.

3 Proposed Model

In this section, a model to assess agent's credibility and reputation is presented, and we started by describing the architecture of an agent based e-commerce market simulator that will be used to test the model. In our simulator, we will have different type of agents which have their own capabilities and activities to develop the system.

3.1 Multi-agent architecture

The main agents involved in our agent based e-commerce system architecture are: buyers, sellers, market and controller, as we can see in figure 1. The agents that play a major role in this architecture are the sellers and buyers, and they will be detailed in next section.

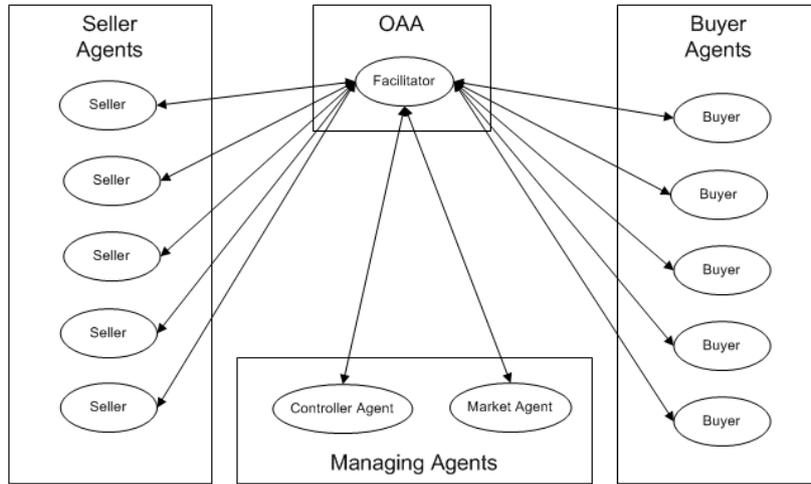


Figure 1 – Agent based architecture

3.2 Sellers and Buyers agents

As we mentioned previously, buyer and seller agents represent the most active and rich entities involved in the system. For that reason we will detail its architecture, main goals and strategies.

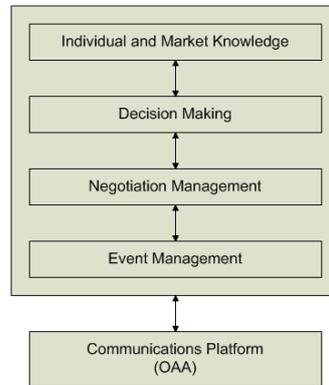


Figure 2 – Architecture of Byers and Sellers agents

Events management module

This module is the lower level of this architecture. Its task is to manage the exchange of messages between agents, thus making the interface with the platform OAA ("Open Agent Architecture").

Negotiation management module

This module has the function of managing the behavior of the agent and it coordinates the period of negotiation with other agents in the system. During this

process of negotiating, the rate of exchange of messages is very high, mainly due to exchange proposals and counter-proposals.

This module is also responsible for the formulation of proposals and counter-proposals. Regarding this functionality, the interconnection between the Management Module of Negotiation and Decision Making Module is very narrow, being the Decision Making module responsible for analyzing the results of previous business and setting goals and behavior to display in current trading.

Decision Making module

This module has the responsibility of analyzing the results and knowledge gained on the businesses that are completed, thus establishing objectives and defining the behavior to be assumed.

Knowledge Module

This module includes information about the agent itself (e.g. the capabilities, the needs) and market information on which it is included. This market knowledge includes information on commitments and knowledge that he acquired on other agents in the market. The historical background of the business conducted is of vital importance for the evolution of the market, because the model credibility and reputation becomes more efficient with the increase of cases to check. The information available in this module will allow a better adjustment of the strategy and of the agents' behaviour.

3.3 Credibility and reputation model

In our model, a new agent in the system will always start with a minimum value of reputation (zero value). With this measure, we intend to avoid malicious agents, creating new entities in the system. We stand up for the consideration of the three dimensions in the reputation evaluation, namely: individual, social and ontological. Firstly, the agent will search on his records and past interactions with the object agent (individual dimension); then he will inquire his neighbours, the witness agents and the Market Controller (social dimension), and finally the evaluation of the real transaction conditions (ontological dimension).

For a better understanding of this module, we must explain in more detail the social dimension. The neighbour evaluation will be obtained by inquiring the highest reputation member of the grader group that had past transactions with the object agent. The process to obtain the witness reputation will be the calculation of the average value of Credibility and Reputation of the object agent group. This value will include all existing evaluations of the object agent group.

At the end of the negotiation process the grader agent, will calculate the value of Credibility and Reputation, using the next presented formula.

$$\bar{x}_p = \frac{p_1 \times x_1 + p_2 \times x_2 + \dots + p_n \times x_n}{p_1 + p_2 + \dots + p_n} = \frac{\sum_{i=1}^n p_i \times x_i}{\sum_{i=1}^n p_i}$$

This formula makes this calculation, giving a weight (p) to every item on the business evaluation (x), and returning a value representative of the Credibility and Reputation of the object agent. In order to the evaluation to be more accurate, the more recent Credibility and Reputation values, obtained from the negotiation process, will have more influence on the calculations. This happens so that an agent with high Credibility and Reputation values does not take advantage of his position to lure agents into false transactions. Figure 3 represents the proposed model.

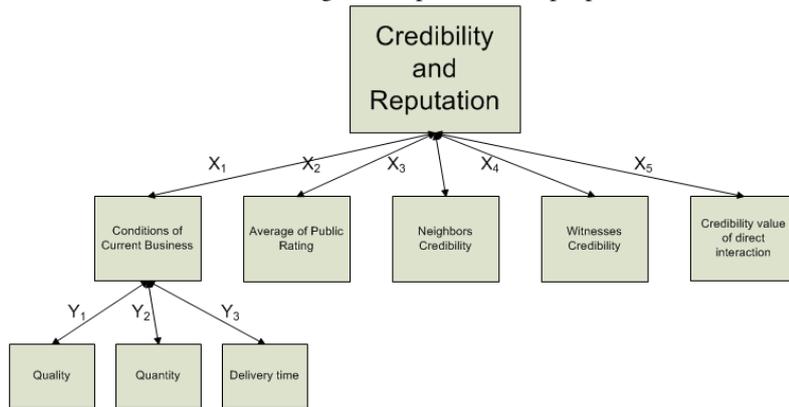


Figure 3 – Credibility and Reputation evaluation model

Figure 3 represents the model with two levels. On the first one, is the accomplishment of the negotiated business conditions. Variables Y1, Y2 and Y3 represent the satisfaction value of the agreed conditions (varying between 0 and 1).

The “Conditions of Current Business” is the only one of the five big scopes of evaluation on this model. The others are:

- Average of Public rating – it represents the average of public assessments made on the target agent (obtained by inquiring the Controller Agent);
- Neighbors Credibility – it will be obtained by inquiring the highest reputation member of the grader group that had past transactions with the object agent;
- Witnesses Credibility – it will be obtained by calculating the average value of Credibility and Reputation of the object agent group. This value will include all the existing evaluations of the object agent group;
- Credibility value of direct interaction – it corresponds to the value associated with the Credibility and Reputation, resulting from direct interaction between the grader and the object agent.

4 Experiments

To evaluate the proposed model, several experiments with different scenarios were performed. In all the scenarios there are have 5 buyer agents and 5 seller agents, and only one type product in bargaining. The configuration of buyer’s agents was

maintained constant in all the scenarios, in order to allow the final values of seller's agent's reputation in different scenarios. For the seller agents, we have considered 3 different scenarios: (1) all agents are genuine; (2) all agents are frauds and (3) we have genuine and frauds.

In figures 4, 5, and 6 it is possible to see the evolution of the reputation throughout the experiments performed with different scenarios.

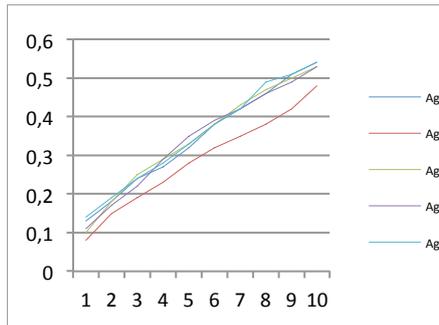


Figure 4 – evolution of the reputation (all genuine)

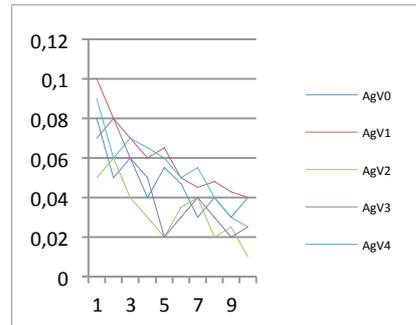


Figure 5 – evolution of the reputation (all frauds)

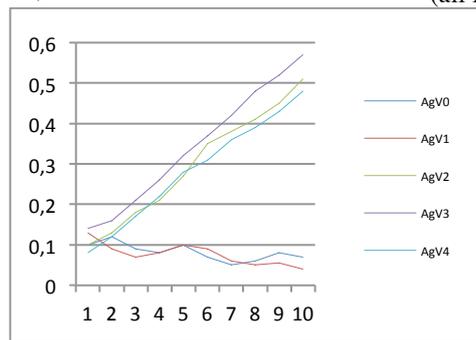


Figure 5 – evolution of the reputation (mix of fraud and genuine)

The results illustrated in figure 3 are in accordance with the expected, because the reputation value of all agents grows (they fulfill the agreement). In figure 4, as expected, the reverse is happens, i. e., the reputation of all sellers is reduced (agents defraud the expectations of buyers). In figure 5 the results illustrate the scenario, in which the reputation of genuine agents grows and the reputation of fraud agents decreases.

5 Conclusion

The proposed solution achieves a satisfaction of all proposed goals, by mixing very different approaches. The acquired knowledge from the state of the art study proved to be very useful for the definition of the Reputation and Credibility model and the development of the simulation system.

The model uses a hierarchical ontology, so it can consider several types of reputation and credibility evaluation at a same time. In this way, it becomes more robust, it provides an evaluation more similar to human behavior and it can also provide a good performance. Possible improvements may come from: applying the proposed model to a real life e-commerce system, which will provide a more solid evaluation of the quality of the model; improve the ontology, to be adapted to any kind of products (an attempt to do this occurred by using MAFRA Toolkit (Silva e Rocha, 2005); apply Bayes's theorem to the proposed model.

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