Improving Trustworthiness in E-Market Using Attack Resilient Reputation Modeling

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ABSTRACT

Asymmetric information is a major problem in e-commerce transactions as it gives rise to adverse selection and moral hazard problems. Reputation mechanisms provide a solution to this problem by discouraging fraudulent behavior and encouraging honest behavior of participants in the uncertain and un-trusted environment of e-market. This paper discusses trust and reputation relationships, and highlights the importance of key reputation building parameters to enhance trustworthiness of participants. Finally, it proposes reputation metrics that guard reputation systems from various attacks by malicious participants to improve the quality of e-market and presents a working prototype.

Keywords: Attack, E-Market, Reputation, Reputation Metrics, Trust, Trustworthiness

1. INTRODUCTION

In recent years e-commerce has shown notable growth by allowing people to interact and trade with others without the constraints of time and space. At the same time, e-commerce transactions in the faceless, vague and uncertain environment are associated with a number of apprehensions that could result in people’s reluctance to participate in online transactions (Beldad, Jong, & Steehouder, 2010; Polovina, 2013). As e-commerce transactions involve interaction among strangers, it requires at least one party to take a substantial risk by advancing trust towards an unknown counterparty (Bentea, Baptist, & Leuschner, 2012). In e-market, generally sellers enjoy an information bias as compared to buyers, as buyers have no access to physical goods before final payment; and, to make buying decisions, they depend on the product description by the seller and their personal preferences (Meng & Chatwin, 2010; Zhang & Zhang, 2011). Hence, it is the buyers who face a greater risk and need protection mechanisms like trust and reputation systems. Reputation and trust systems play a key role in mitigating information asymmetry and transaction risks by

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encouraging honest behavior and discouraging fraudulent behavior of participants.

The purpose of reputation in the real world is to predict a person’s behavior based on self-experience or others’ opinion in order to lower the risk involved in the trust decision that whether to interact/trade with that person or not. This same trust assessment is reflected in the WEB using online reputation systems, which offer aid in making a decision about whether to trust someone in a particular context (Carrara & Hogben, 2007).

Different disciplines treat trust as a research interest in significantly different ways. Trust is generally regarded as an individual trait based on the individual’s estimation of the probability that trust will be reciprocated (Mui, Mohtashemi, & Halberstadt, 2002). It is also considered as an expectation of another party in any interaction or transaction. In e-market, the purpose of trust is to reduce the risk perception involved in transactions. Therefore, it can be said, that increase in trust is expected to positively impact purchase decisions of buyers.

The concepts of trust and reputation are strongly related: reputation enables trust (Carrara & Hogben, 2007); and, disposition of information quality, security concerns, and the reputation of sellers have strong effects on buyers’ trust in the e-market. In general, trust is a personal belief based on a host of factors including reputation. In addition to personal experience, reputation combines the collective opinion of all or some members in an environment, leading to trust or distrust.

Experience and familiarity with an online partner is a major contributor to reputation and trust as people easily trust those whose trustworthiness has been tested in the past (Mayer, Davis, & Schoorman, 1995). Reputation is a mechanism for looking backward in time by testing whether a participant behaved as per expectations or not. Reputation models build on computational notions of trust resembling the trust relationships among human beings, where trust is modeled among computing agents as notions of reputation (Nielsen & Krukow, 2012). In e-market, a reputation system must be able to distinguish between normal or biased behavior in order to reward honest and to sanction rogue participants for fraudulent behavior in the form of different attacks. If not identified and penalized, malicious parties can repeatedly cheat, and not only reduce the trustworthiness of honest members but also trigger failure of e-market.

This paper describes trust and reputation relationships and proposes a number of useful metrics/parameters of a reputation function that help to enhance the trustworthiness of its participants. The proposed reputation functions reward honest participants and penalize cheaters to protect honest participants from different attacks on the reputation system. We also simulate a working prototype of a reputation system based on these parameters.

In the rest of the paper, section 2 includes literature work. Section 3 presents trust and reputation concepts, and section 4 elaborates on their relationships. Reputation parameters that enhance robustness and trustworthiness of the reputation system are discussed in section 5, based on which useful reputation metrics are defined in section 6. Section 7 comprises of a working prototype and section 8 presents an experimental analysis. A discussion comprising of a comparative analysis of the proposed system is provided in section 9. This paper concludes with section 10.

2. REPUTATION AND TRUST MODELS IN LITERATURE

Trust and reputation concepts are popular due to the need of trustworthy automatic tools in e-commerce; and due to their ability to automate processes, multi-agent systems have been widely used in e-commerce (Majumdar & Mishra, 2009; Majumdar & Mishra, 2010). However, trust and reputation terms are used with a variety of meanings (Salehi-Abari & White, 2009), and to reduce confusion - a consistent terminology is required.

A number of studies have established reputation systems to be extremely important trust-building mechanisms in e-commerce (Resnick,
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