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Procedia Computer Science 10 (2012) 902 – 908

**Procedia**  
Computer Science

The International Symposium on Advances in Transaction Processing

## A Twitter-Based Weighted Reputation system

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### Abstract

*Trust between buyers and sellers plays an essential role in online shopping. Therefore, reputation systems are, typically, integrated with online shopping systems to form trust decisions between sellers and buyers. Online Social Networks (OSNs), such as Twitter, LinkedIn, MySpace and Facebook connect people from all over the world in a virtual community. OSNs can provide information about the relationships between people. This information can be used to improve the reliability of reputation systems. With twitter having over than 200 million users and due to its microblogging nature, we choose twitter as a basis for a reputation system.*

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**Keywords:** Online shopping; Reputation; Social networks; twitter

### 1. Introduction

Online marketplaces, such as eBay and Amazon, are online shopping systems which provide a fast and a cost effective way for purchasing products online. The buyers can use these online marketplaces to view and buy the products that the marketplaces offer. A major problem that appeared in online marketplaces is the lack of direct communications between the buyers and the sellers. Moreover, the buyers cannot examine the products before purchasing. This will result in many trust problems and misunderstanding issues between buyers and sellers.

Most online marketplaces adopt reputation systems to build a measure of trust between sellers and buyers. Reputation has been defined as public opinions and thoughts about a certain thing or object. Reputation systems are considered as important methods that are employed to form trust decisions in online marketplaces. These reputation systems are based on ranking techniques. The buyers can rate the sellers after the completion of their transactions through online marketplaces. The rates will assist other buyers in deciding whether or not to deal with a particular seller in the future. In addition, reputation systems are used to gather and manage the rates submitted by buyers. Thus, when a user needs to know if the seller is trustworthy, he can check the rates that are submitted by other buyers which, previously, had interact with

the same seller. However, not all the rates are honest and fair, where the rates and reviews can be manipulated by a group of people to trick the customers to deal with a seller which may not deliver the purchased goods [12]. Therefore, there is no trust between the person who wants to purchase from a rated seller and other buyers who rated that seller. In order to solve this problem, namely, trust issue, online social network can be employed to build trusts relationships in online systems.

An Online Social Network can be represented as a networking system which is composed of a set of nodes that are connected by a set of relationships [1]. A node may represent a person, an organization, or other entity. A relationship could be a friendship, an affiliation, or a knowledge exchange. Online Social Network, such as Twitter, Facebook, and MySpace, can build strong and various social relationships between their members which can be used to support the reputation systems which are integrated with the online marketplaces. Nowadays, online social networks are attracting a lot of people and they became the major resources for getting the worldwide information and connecting people. One of the most growing online social networks is twitter.

Twitter has gained a huge popularity because it provides a fast online interaction and communication. Twitter is an online social network and a microblogging tool that provides the users with the ability to post and update their current status (i.e., tweets), re-tweet others tweets and send direct private messages to their friends online. It is the most up-to-the-second updated search engine tool that keeps its users updated with the recent events and news. Moreover, people who share the same interests and activities can follow each other and spread their knowledge. Therefore, twitter is suitable for fast information exchange between different buyers which use the same marketplace. In addition, it provides a good indication about the relationship between people. In this work, we present a Twitter-based weighted reputation system. The proposed reputation system is personalized according to the viewer where it assigns different weights to the reviews submitted by other buyers depending on their relationship with the viewer.

The rest of the paper is organized as follows. In Section 2, we review the related work in the area of reputation systems. We mention the reason for choosing twitter as social network in our proposed system in Section 3. In Section 4, we describe twitter main features and present the proposed reputation system. Finally, we conclude and present the future work in Section 6.

## **2. Related Works**

Reputation systems have gained a huge attention due to its importance in many areas. Reputation is defined as a trust expression and a global trust status in social groups [2]. In addition, reputation is, generally, represented by rating an object in a given context; the context includes the relevant events [2].

Several models and analyses for reputation systems have been proposed. In [2], a general Role-Based Reputation Model (RBRM) has been modeled for representing a reputation system which uses reputation roles as fundamental unit to control the reputation system by collecting and organizing reputation information. The work in [3] deals with the rating issue in the reputation system. It proposes a Rating Reputation Feedback (RRF) mechanism to prevent and reduce dishonest ratings which affect the reliability of reputation systems causing trust and security problems. In RRF mechanism, rating reputation is determined by connecting a system ratings with its rating reputation and continuously changing the rating reputation using feedbacks of subsequent other ratings. The authors in [4] presented a personalized reputation system. This system handles how an individual person trust another person by using a stochastic approximation algorithm to determine two types of opinions, the individual personal opinion and others opinions, which then are joint together using a weighted linear sum. An online reputation system called TrustDavis is presented in [9]. TrustDavis system builds trust between individuals using

trading online strategies. This reputation system discovers the relationships between individuals to protect them from trade fraud. A theoretical model of eBay's reputation mechanism has been suggested in [10]. The suggested model offers an approach to control and handle responses coming from both buyers and sellers.

The idea of integrating social networks with reputation systems has been considered in previous works [5, 6, 7]. In [6], friendship annotations are added to enhance the reliability of reputation systems. These annotations are used to enable users to recognize the online reviews written by their friends. The work in [6] extends the scheme proposed in [6] by integrating online social networks to online shopping sites using a protocol which allows the posted reviews submitted by the buyer to be read by the close friends of the buyer. In [7], pair-wise trust ratings and reliable factors of acquaintances are used to construct a weighted-graph which is used to compute the trust values.

In our proposed system, the trust between individuals is formed in a different way. Trust is evaluated based on the strength of the relationship between individuals. Therefore, the reliability of the ranking system is enhanced by considering the interaction and relationships between buyers in twitter. In addition, the system provides an easy way to exchange information about a particular seller between friends and other users.

### 3. Motivation

To analyze the reliability of typical reputation systems and the trust levels between twitter users, a survey has been conducted. The survey has been completed by 103 persons. The results indicate that 86.4% of people agree that the reputation and ranking systems help them in making their online purchasing decisions. The results also indicate that *most buyers are facing trust problems with reviews posted by anonymous people*, where only 11.1% of the people said that they trust reviews posted by anonymous buyers by above 75%, while the remaining responses indicate that the trust level of the reviews is below 75%, and 17% of the people said that they don't trust reviews and ranking values submitted by an anonymous.

In the survey, we have also evaluated the trust level between twitter users. The results show that 51.5% of the people trust the people who they follow (i.e., has unidirectional relation), while 58.8% of the people trust the people who they follow and they follow them back (i.e., has bidirectional relation). At the end, the responses are asked whether a new reputation system which is integrated with twitter will help them to purchase more from an online shopping website, 41.7% of the responses answered with yes. Therefore, a new ranking scheme which utilizes the relationships of twitter users can enhance the reliability of reputation systems, as we describe next.

### 4. Proposed Reputation System

In this section we describe the proposed Twitter-based reputation system. In this reputation system, the ranking of each seller is personalized depending on the viewer. The reputation value of a seller is estimated as a weighted sum of the ranking values submitted by other buyers. In Section 4.1, a description of the problem that we address is presented along with the system elements. In Section 4.2, the main twitter features are explained. The proposed weighted reputation system is described in Section 4.3. In Section 4.4, we discuss how a buyer can build relationships using this system so that he can increase his benefit.

#### 4.1 Problem Description and System Elements

The system consists of twitter accounts and an online marketplace such as eBay. We assume that the integration between the online marketplace and twitter has been completed. This is a valid assumption as many current online website allows the users to access their website using the user social network account. We further assume that the market consists of two types of actors' buyers and sellers.

We assume that a transaction between a seller and a buyer is carried on as follows. When a buyer agreed on the product price offered by the seller, the buyer must pay before the seller sends the product. In the ideal case, after paying, the seller must deliver the product to the buyer at a certain time and with the expected quality. However, the seller might not fulfill the buyer's expectation by sending a product with lower quality. Even worse, the seller may refuse to send the product. To cope with dishonest sellers, reputation system is adopted in the online marketplace.

4.2 Twitter Features

In twitter, each user, X, has two types of relations with other users: "Followers" and "Following". A Follower of X can view his profile, receive and re-tweet his tweets. When X is "Following" another user Y, he will be subscribed to Y's tweets. Hence, X will be treated as a follower of Y.

Twitter offers a privacy feature by which the user can restrict the people who can follow him/her. This feature is activated by making the profile private. In this case, a user which wants to follow a user, X, with a private profile must send a request and this request must be accepted by X.

In addition to regular tweets, Twitter offers re-tweet and mentions as other ways for communication. A re-tweet is re-sending a tweet of another person. A mention is a kind of tweets and twitter updates that contains another twitter username. It is used for different purposes such as to praise or recommend someone. The mention will be showed up in the sender and recommended person's timelines. It's represented as @username, where the username is the recommended person. When a user replies on another user, this reply is considered as a mention.

The relations in twitter could be bidirectional or unidirectional. Fig.1 illustrates the types of relations in twitter. Fig 1(a) shows the bidirectional relation where both users, X, and Y, follow each other. The unidirectional relation is illustrated in Fig.1(b) where user X follow user Y while user Y doesn't follow user X.



Fig 1. Relationships in Twitter: (a) Bidirectional relation; (b) unidirectional relation

4.3 Twitter-Based Reputation System

The main idea of the proposed Twitter-Based Reputation system is to utilize the available information in the user's twitter accounts to improve the reliability of the ranking system as well as to use twitter to increase the interaction between the buyers.

The system requires that the marketplace has a twitter account linked with its website. In addition, the marketplace website asks the new users to provide their twitter accounts when they register to the system. Note that the proposed system mainly targets the users that are using the marketplace website and they

have a twitter account. However, we emphasize that the system doesn't force the buyer to have a twitter account and buyers with no twitter accounts can still benefit from some of the functionality provided by the system.

The reputation system works as follows. After the transaction between a seller and a buyer has been completed, the buyer will be asked to rate the seller and to write an optional review. The buyer can specify the privacy level of his review. Specifically, he can choose between three options: public, private, and none. Fig.2 illustrates the interaction between the marketplace, buyer twitter account, seller twitter account, and marketplace twitter account.

In the public option, the buyer's review and rate are posted in the marketplace website page, buyer's twitter account, seller twitter account and the twitter account of the marketplace.

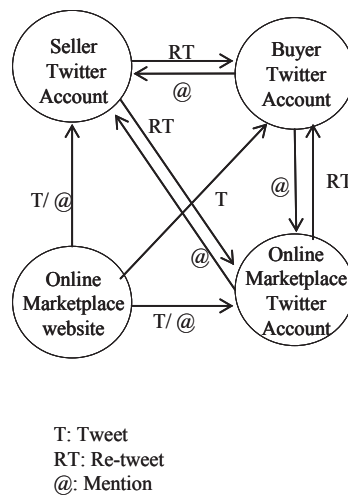


Fig 2. Twitter-Based Reputation System Interactions

In the private option, the buyer's review and rate are posted in his twitter account only. Finally, in the none option, he can choose to not reveal any information about his purchase and not to write any review. Moreover, the marketplace and the seller can re-tweet (RT) their customers' public tweets to publish the buyers reviews which will result in gaining more reputation. More reputation will be result from re-tweeting public review because the marketplace and the seller followers will receive the review and then this may made them wants to know more about the product or to purchase it. When a buyer chooses the private or public option, he will benefit by letting his friends know about this marketplace, thus, they may subscribe and then their experience, with the sellers, will be included in computing the reputation score of the sellers, as we describe next.

For each seller  $i$  and buyer  $j$ , let  $R_{ij}$ ,  $F_{ij}$ ,  $S_{ij}$  be sets of users. Each set is described as follows:

- $R_{ij}$ : a set of users who follow buyer  $j$  and buyer  $j$  follows them back (i.e., they have a bidirectional relation, as shown in Fig 1(a)). In addition, these users ranked seller  $i$ .
- $F_{ij}$ : a set of users who are followed by buyer  $j$  (i.e., they have a unidirectional relation, as shown in Fig 1(b)) and they have ranked seller  $i$ .

- $S_{ij}$ : a set of users that do not have a relation with buyer  $j$  (i.e., he is neither a follower nor a following) and they ranked seller  $i$ .
- $R_{ijk}$ ,  $F_{ijk}$ , and  $S_{ijk}$ : the rank value submitted by the  $k^{\text{th}}$  user in set  $R_{ij}$ ,  $F_{ij}$ , and  $S_{ij}$ , respectively.

The reputation score of a seller  $I$ , which is viewed by buyer  $j$ , is estimated using equation (1). The rank values submitted by the users are weighted depending on their trust relationship with buyer  $j$  ( $w_1$ ,  $w_2$ , and  $w_3$  in equation (1)).

$$Reputation\_Score(i,j) = w_1 \times (\sum_{k=0}^n R_{ijk}) + w_2 \times (\sum_{k=0}^m F_{ijk}) + w_3 \times (\sum_{k=0}^l S_{ijk}) \quad (1)$$

where,

$n$ : number of users that have a bidirectional relation with buyer  $j$

$m$ : number of users that have a unidirectional relation with buyer  $j$

$l$ : number of users that are not related to buyer  $j$ ,

$w_1 > w_2 > w_3$

and  $w_1 + w_2 + w_3 = 1$

The weight assigned to users in set  $R_{ij}$  is higher than that assigned to users in set  $F_{ij}$ . This is due to the fact that the users in set  $R_{ij}$  have a bidirectional relation with buyer  $j$ , while the users in set  $F_{ij}$  have a unidirectional relation (buyer  $j$  follows them but they didn't follow him back). Thus, there is a high probability that the relation between buyer  $j$  and users in  $R_{ij}$  is stronger than that with users in  $F_{ij}$ . Hence, there is a high probability that buyer  $j$  trust users in  $R_{ij}$  more than he trust users in  $F_{ij}$ . The rank values submitted by users in  $S_{ij}$  are assigned the lowest weight as there is no relation between buyer  $j$  and them (i.e., they are anonymous to buyer  $j$ ). This way the reputation system can have more reliability and, thus, the users will have more trust in the system.

The weights values  $w_1$ ,  $w_2$ , and  $w_3$  can be assigned constant values or generated by analyzing the trust between buyer  $j$  and other users in sets  $R_{ij}$ ,  $F_{ij}$ , and  $S_{ij}$ . There are many approaches to analyze trust between users in social networks, one of the recently proposed approaches is SWTrust framework [11]. SWTrust builds trusted graphs in online social networks to evaluate trust value between the users. This framework includes determining Preprocess Social Network (PSN), developing Build Trust Network (BTN), and creating Generate Trusted Graph (GTG).

#### 4.4 Building Relations

A user may gain a relation with other users in the marketplace by observing their opinion and compare it with his personal experience. For example, if user  $X$  read the review of seller  $A$  which is written by user  $Y$  and  $X$  has deal before with seller  $A$  and his opinion match user  $Y$  opinion, he can follow user  $Y$  so that he can benefit more from his reviews.

### 5. Conclusion and Future Work

Reputation systems have gained huge popularity in online systems because of its importance in making decisions especially for people who are extensively using online shopping systems for purchasing their needs. The functionality of reputation system is to collect and manage the reviews and ratings that are submitted by the buyers.

In this paper, a new reputation scheme has been proposed which is integrated with an online social network, twitter, to build trust relationships between the buyers who use the same online shopping

systems. In this system, the relationships between twitter users have been utilized in order to build a reputation framework with a personalized weighted ranking system.

For our future work, we are planning to evaluate the overall system efficiency by calculating the system performance. The system performance will be determined by estimating the time taken to access twitter and getting all the information needed to calculate the reputation score. In addition, different approaches to generate weight values can be evaluated.

### Acknowledgements

The authors would like to acknowledge the contribution of "Dr. Maythem Safar" from Computer Engineering Department in Kuwait University.

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