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# Research on Transaction Security Mechanism of Mobile Commerce in Mobile Internet based on MAS

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## *Abstract*

*In Mobile Internet (MI), existing uncertain factors, such as randomness, fuzziness and unpredictability, brought many security issues to on-line transactions. In on-line transactions of the mobile commerce based on mobile Internet, the trust is the premise and key which makes transactions smoothly.. Trust measurement between entities involves in trading volume, transaction time, personal income of consumer entity and its risk attitude to trust, and so on, which is difficult to be given accurately quantitative calculation. To find out the essential features of this kind of trust relationship, combined with cognitive theory and methods of social network in real life, in the research background of mobile commerce in Mobile Internet, by the research on problems in MI, such as trust, influencing factors to trust and trust mechanism, based on multi-Agent system coordination theory, a dynamic trust calculation model based on mobile Agent is given. The model can achieve the qualitative and quantitative conversion of trust. In order to effectively prevent credit speculation and fraud of malicious user, the paper presents evaluation methods of special attributes and punishment methods of. trust. To implement incentive mechanism for achieving credibility, the paper defines the time-sensitive functions, which makes dynamic attenuation of the trust. The existing trust assignment methods of new users are improved, and a new method is proposed which sets dynamically initial trust of new users based on minimum trust of the previous system, and effectively resists moral hazard of discarding reputation information. Through leading the evaluation system of trading and weighting system into the multi-factor mechanism, the model reflects better the impact of subjective factors on trust calculation, such as individual preferences, risk attitudes, enhances the sensitivity of the trust algorithm on single property of transaction. The detailed theoretical analysis and simulation results show that the mechanism can effectively reveal and resolve the trust computing problem of mobile network transactions and provides a valuable new idea to* ***transaction security*** *in MI.*

***Keywords:*** *Mobil Internet, Mobil commerce, Dynamic trust model, Reputation Management, Mobil agent system, Online Transaction Security*

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## 1. Introduction

In recent years, as mobile Internet development of mobile commerce is rising rapidly. According CNNIC2014 August China internet development statistics report network "China's mobile Internet research report" shows that as of the end of June 2014, the total number of mobile Internet users to 527 million people [1], in which users are using online shopping accounts online the proportion of services to 41.8%, the annual growth rate of online payment and online banking were 46.1% and 48.7%. According to the Ministry of Industry and Information Technology, as of the end of 2013, the number of domestic mobile phone users has more than 797 million. Huge user base and to promote 3G / 4G technology for the development of mobile business provides a good foundation. Mobile commerce makes consumers anytime, anywhere can carry out business activities. Online transactions not only to improve the convenience of the transaction, to expand the temporal and regional trade, become the new driving force of economic development. However, while the development of online transactions, but also by some threat potential factors [2].Mobile Internet itself has the virtuality, anonymity, uncertainty, randomness and dynamic characteristics often make network counterparties insecurity and distrust [3].

Due to the lack of overall control, network virtual environment users can not trust through face to face contact, identity fraud, false information dissemination, reject or postpone delivery, quality and after-sales service has become a bottleneck in the healthy development of mobile commerce. Therefore, the trust mechanism of mobile commerce industry is increasingly becoming the focus of attention. Trust as a prominent mobile e-commerce security issues throughout the entire transaction process, restricting the development of mobile e-commerce [4]. Meanwhile, the current online transactions with related supporting law is not perfect, weak supervision, malicious behavior that breaches false trading, online fraud has occurred frequently. The mobile Internet research report shows that online fraud, lack of credit, etc. have seriously hindered the development of online transactions, the current mobile Internet market needed to build a suitable development of robust online trading trust model, providing a good credit environment for the development of mobile e-commerce. Therefore, many scholars and trading site using different theoretical approaches, a trust model is proposed based on a variety of theories, in order to solve the existing problems of the existing trust calculation method in mobile commerce, promote online transactions smoothly.

At present, the vast majority of C2C site is using simple method to calculate the total or average trust, to assess the transaction user reputation status. But this method has some obvious flaws, do not consider the transaction value, transaction times, ignoring the score credit status, score time weight consistency, is easily affected by low credit ruined and destroy malicious recommendation and other malicious behavior [5-7].

The present research of trust model trust ignored characteristics of multi-dimensional, unable to trust comprehensively and personality assessment, there fore, in order to build a suitable mobile e-commerce development, and contribute to the smooth conduct online transactions credit environment, need to continue to further analysis ignores the problem of the current trust model, to build a more suitable dynamic trust model to quantify the mobile network environment. This paper presents an Agent for mobile e-commerce trust computing model complex dynamic mobile network environment, established a mechanism of credit system suitable for mobile commerce and trade safety, safeguard the normal order of mobile network transactions.

## 2. Describes Related Work and Related Issues

In recent years, on the network transaction trust and evaluation problems, many scholars carried out in-depth research, put forward a variety of trust and reputation

 

systems. According to the different techniques, the trust and reputation systems can be divided into the simple average model, Bayesian model, discrete trust model, based on evidence theory model, fuzzy model, streaming model [8-30].

Although these models are partially solved in different contexts trust modeling and evaluation issues, proposed the corresponding trust evaluation model, evaluation methods or assessment mechanisms, but these models are still many deficiencies exist. For example: Because of the complexity of the network environment of trust has randomness, uncertainty and unpredictability characteristic vagueness, etc., it is difficult to quantify precisely describe, but most of these models use the classical mathematical theory (such as probability theory, fuzzy theory) to express the relationships between entities and trust metrics, these models of trust (rational) expressions, measure (theory) and other aspects of the trust are not perfect; There is no effective solution to malicious recommendation evaluation to the influence caused by the lack of trust; lack of flexible trust evaluation mechanism, does not reflect the different entities to assess personality traits when trust has. And with the increasing number of e-commerce transaction entity, trusted computing time complexity and space complexity will increase exponentially, how to reduce the trust computation time and space complexity and ensure trust computation in real time, dynamic and accuracy is the key of trust metrics into a step towards practical. On the other hand, the current large-scale e-commerce sites (such as eBay, Taobao) the trust evaluation mechanism based on reputation is relatively simple, only through each buyer seller after the completion of a deal on reputation evaluation results presented average, not considered by friends and relatives, friends, classmates, colleagues, neighbors, the community and social relationships network and reputation (Word-of-Mouth) the role of the support, do not rule out the fraud sellers register themselves multiple buyers account, multiple purchases and give yourself a high reputation evaluation, so that the seller's credit evaluation results of total credibility to the poor.

Based on the above issues, this paper draw lessons from the previous research work, and the authors in the literature [31-36] research results, introduced some attributes of social trust relationship into the virtual commerce environment, in the complex environment of mobile Internet mobile commerce research background, through the issue of mobile network environment of trust, confidence influencing factors and trading mechanisms were analyzed, essence focuses on trust relationship network under the environment of mobile commerce, the introduction of collaborative computing theory, proposes a mobile network environment for complex dynamic trust computation model based on MAS cooperation. tablished a set of suitable for mobile e-commerce trust model and security trading mechanism, to reduce the trust computation time complexity and space complexity and increase trust evaluation accuracy and practical purpose.

## 3. Trust Model based on Collaborative Filtering of Mobile Network Transactions MAS (CFBC)

### 3.1. Trust and credibility Mobile Agent Commerce System

In P2P, the Web service, electronic trade, electronic commerce, autonomic computing, grid and pervasive computing and other fields of study, trust is considered one of the key problems. Because Agent-based computing is a natural computational model of these systems, which generally trust research in many fields can be carried out in Multi-Agent Systems (multi-agent system, MAS) of angles [37-38]. Generally, MAS is a system consisting of autonomous, reactive, pre

 

mobility and social. Computational entities (Agent) interaction through specific mechanisms and protocols.

Here are the concept of trust and reputation of mobile Agent in e-commerce environment based on.

**Definition 1 (Trust)** In the mobile Agent commerce environment, refers to Agent based on their knowledge and experience gained in the past to determine the interaction of the resulting trust, that trust is a trust to assess user (Agente) based on their direct experience of the history of the transaction, to be evaluated node the network's reputation and network environment factors, willingness to be evaluated for the node (Agentp) within the agreed time successfully submitted in accordance with the agreement of the agreement, the capacity and trustworthiness of the faith, also known as direct trust, it reflects the subjective opinions Agent . Trust is generally trusted by the trust were on the capability and reliability of a judgmental beliefs, is a trusted person can complete a task or undertaking expectations. Trust, including a lot of content, such as the history, strength, environment and conditions of angle from the perspective of subjective preferences, etc. can trust, and the trust relationship dynamics change over time, the context, the environment and many other factors. At present, there are interactive trust and recommendation trust. trust Agent relationship is an important basis for partner selection.

**Definition 2 (credit)** in mobile Agent commerce environment, credit refers to other Agent by collecting Agent environment point of view, through their own processing that trust.

**Definition 3** (**trust degree**) trust degree user nodes (Agentc) for the business node (Agentp) to quantify the degree of trust.

**Definition 4 (trust management)** trust management is mainly on how to integrate the trust and reputation, as well as the preservation trust, update and transfer in the open network environment, calculate the interaction between the presence of trust interaction Agent, there is no interaction between the Agent to recommend trust or reputation as a supplement.

Trust management theory is an important foundation for the work of dynamic trust model [42-43], the degree of trust involved in the interaction between objects in real-time computing, should get some confidence interactions possible, and provide decision-making assistance. For open dynamic environment, many scholars use mathematical methods and tools to create different models that quantify the various elements of the trust hopes to build relationships of trust appropriate description.

### 3.2. Mobile Internet Trading Dynamic Trust Calculation Model

User u at time t trust computing model is [36]:

$$\tau_t(\mathrm{u}) = \begin{cases} \alpha\tau_{t-1}(\mathrm{u}) + \beta \cdot \bar{f}(\mathrm{x},\mathrm{u}) \cdot \mathrm{e}^{\sum_{k\in N(\mathrm{u})} w[\mathrm{p(x,u)}]\cdot \mathrm{Cr}[\tau_{t-1}(\mathrm{x})]\cdot \rho(\mathrm{t}_x,\mathrm{t})} & , N(\mathrm{u}) \neq 0 \\ \tau_{t-1}(\mathrm{u}), & N(\mathrm{u}) = 0 \end{cases} . \quad (1)$$

Among them, $N(u)$ is a set of user transactions, i.e. the set of [$t$-1,$t$] in the time domain, the user u of the user transaction. $\tau_{t-1}(u)$ represents t-1, the user u trust. For $\forall x \in N(u)$ , $\tau_{t-1}(u)$ represents t-1, the user u trust. W[p(x,u)] is the weight function of the transaction value, which can be written as:

$$w[p(x,u)] = \frac{p(x,u)}{200} . \quad (2)$$

Among them, $p(x,u)$ in [$t$-1,$t$] time domain, the value which the user $x$ and $u$ the transaction. $\mu$ is the network system (auction) the minimum value of transactions, the transaction value to meet the insurance claim.At present, eBay just for the transaction value of not less than $200 deal with insurance. According to the 2009 i

 

Research "China Online Auction Research Report", now the average trading price of the auction items traded at around $ 200.

$Cr[\tau_{t-1}(x)]$ is the weight of user trust value *x*, said the credibility of the user u transaction object x given feedback evaluation scores of credibility.

$t_x \in [t-1,t]$ represent the time users x and u to carry out the transaction; $\rho(t_x,t)$ is the time discounting function,said time weight of reputation feedback evaluation score, when $t_x$ leaned closer to *t*, the weights are user Agent *x* to user Agent *u* gives reputation feedback evaluation score is higher,

$$\rho(t_x,t) = \rho^{t-t_x}, 0<\rho<1, (\rho \text{ is the time weight factor}). \tag{3}$$

$\bar{f}(x,u)$ is average reputation feedback evaluation scores which Agent *x* score for Agent *u*, after the end of the sale,

$$\bar{f}(x,u) = \frac{\sum_{i=1}^{|C|} \omega_{ci} f_{ci}(x,u)}{\sum_{i=1}^{|C|} \omega_{c_i}} c_i . \tag{4}$$

Where, $|C|$ is the base consisting of set$\{c_1,c_2\ldots,c_n\}$ of the credibility of the key factors. $f_{c_i}(x,u)$ is the user Agent *x* feedback evaluation score to the user Agent *u* at the credibility of key elements of the $c_i$ conditions.

$f(v,u)$ is the reputation degree feedback evaluation and after the user u the success of the transaction the user V to the user u, $f(v,u)$ is an n-dimensional vector under C1, c2,... ,cn, that is $f(v,u)=(f_{c_1}(v,u), f_{c_2}(v,u),\ldots, f_{c_n}(v,u))$, $f_{c_1}(v,u) \in [-1,1]$ is feedback evaluation score that user V given to user u within ci credit key factor; $\omega_{c_i} \in [0,1]$ is the weight value system set the credibility of the key factors $c_i$, represent all all participate in the online auction transaction user Agent on the key factors of credit $c_i$ consistent degree of goodwill.( Model system through analysis of the relevant transaction data obtained, it can be directly set all credibility key factor equal.)

$\alpha$ is Recent trust; $\beta$ is Credit feedback score transaction that $x \in N(u)$ the user u trading partners to submit.

### 3.3. Feedback Evaluation User Trust Degree Weight Calculation

We use the method based on collaborative filtering to calculate the score of user trust degree weights, the idea is: that individual transaction records in accordance with the target user Agent *u* by solving the target user Agent *u* User Agent *x* and score on the same trading partners to evaluate the degree of similarity scores to assess the value of user trust score of Agent *x* weight $Cr[\tau_t(x)]$.

Given target user Agent *u*, user ratings Agent *x*, set $N(u)$ for the target user's trading partners Agent *u* the set consisting of, $N(X)$ is a user rating Agent *x* trading partners collection, $CN(X, u)$ set is composed of the target user Agent *u* and transaction user Agent *x* common trading partners. Because trust in the credibility of the feedback calculation model is a vector multidimensional evaluation score, so the credibility of the feedback between the degree of similarity scores solving user Agent when we use cosine angle to solve [43].

Given two vectors *x* and *y*, the angle between the application of the cosine similarity degree method to solve for *x* and *y*(Pearson similarity measure formula), is expressed as follows:

$$sim(x,y) = \cos(\bar{x},\bar{y}) = \frac{\bar{x}\cdot\bar{y}}{\|\bar{x}\|\cdot\|\bar{y}\|} = \frac{\sum x_j y_j}{\sqrt{\left[\sum x_j\right]^2 \cdot \left[\sum y_j\right]^2}}, \tag{5}$$

For a given target user Agent *u*, scoring user Agent *x*, then the value of the right to score trusted user Agent *x* 's weight $Cr[\tau_t(x)]$:

$$Cr(\tau_t(x)) = sim(x,u) = \frac{\sum_{k \in CN(x,u)} \cos[f(x,k), f(u,k)]}{|CN(x,u)|} = \frac{\sum_{k \in CN(x,u)} \frac{\sum_{i=1}^{|C|} f_{c_i}(x,k) \cdot f_{c_i}(u,k)}{\sqrt{\left[\sum_{i=1}^{|C|} f_{c_i}(x,k)\right]^2 \cdot \left[\sum_{i=1}^{|C|} f_{c_i}(u,k)\right]^2}}}{|CN(x,u)|}$$

, (6)

### 3.4. Trust Penalty Method

If a user last transaction failure, should be punished on them to prevent fraud from happening. Punishment according to the amount of the transaction to determine the amount of punishment, and the historical average difference is bigger, the greater the likelihood is cheating, so the punishment should be greater. Therefore, we give a method of punishment, namely, minus the in based on the existing trust value of a penalty points, calculated as follows:

The formula |CN (x, U) | targeted Agent u, scoring user Agent x common trading partners set base ; $k \in CN(x, u)$ is trget user Agent u, scoring user Agent x common trading partners; $f(x, k)$、$f(u, k)$ is rated user Agent *x*, the target user Agent *u* common trading partners based on reputation and credibility of the key factors C Feedback Assessment (vector). Ratings User Agent *x* and target user Agent *u* evaluation score closer, scoring the right user Agent *x* trust value $\tau_t(x)$ greater weight $Cr[\tau_t(x)]$.

The calculation method based on collaborative filtering, can not only weight measurement scale of user trust, and by calculating the score of user $x(\text{Agent}_e)$, user $u(\text{Agent}_p)$ score similarity, negative effect can effectively reduce the credit against fraud. If $x(\text{Agent}_e)$ is part of the user set score gang conspiracy, that $x(\text{Agent}_e)$ is only positive reputation for gang members to submit feedback rating and provide malicious users to other transactions negative reputation feedback score. While the target user $u(\text{Agent}_p)$ for honest users, the score of user $x(\text{Agent}_e)$, user $u(\text{Agent}_p)$ similarity scoring will be very low.So the score $x(\text{Agent}_e)$ user submitted negative reputation feedback trust degree calculation on the target user $u(\text{Agent}_p)$'s influence will be smaller, so as to prevent the fraud reputation vilified in a certain sense.

$$\tau_t(\mathrm{i}) = \tau_0 - (\mathrm{R}_i^{\max} - \mathrm{R}_i^{\min}) \times (1 - \frac{\sigma}{10}) \tag{7}$$

Where, $\tau_t$ is the trust value after punishment, $\tau_0$ is the trust value punishment before; $\mathrm{R}_i^{\min}$、$\mathrm{R}_i^{\max}$ are before punished their trust level interval the lower bound and the upper bound; $\sigma$ rating score for the transaction amount, according to equation (10) calculated to give , divided by 10 in order to format the data into the interval [0,1].

Set a property consists of *W* grades, which the evaluation of i grading score interval is $[\mathrm{R}_i^{\min}, \mathrm{R}_i^{\max}]$, $\mathrm{R}_i^{\min}$、$\mathrm{R}_i^{\max}$ are respectively the lower and upper interval, the interval evaluation score recorded as, calculation method:

$$\sigma = \mathrm{R}_i^{\min} + \theta \times (\mathrm{R}_i^{\max} - \mathrm{R}_i^{\min}) \tag{8}$$

For example, a property is divided into poor,middle and the good three levels, respectively [0,4], [4,7] and [7,10] interval. If a user is currently a total of 100 evaluation ("poor" 30 months, "middle" 40, "good" 30), assuming that the evaluation of the heavy weights of all are 1, according to equation (10) is calculated comment on "poor" score is

 

2.9, comment on "middle" scores value of 5.5, comment on "good" score is 7.3, which is to make a quantitative evaluation level to achieve the transition from qualitative to quantitative.

According to this method, each entity in the rating score is not fixed, it is also very reasonable. But different entities in the same trust within a class, calculated trust value may also is not the same,which is preferably obtained with them evaluation related to obtaining "good" evaluation of the proportion of the higher its value, the higher the score.

### 3.5. Dynamic Update of Trust

Trust is sensitive, one of the advantages of this article trust model is to allow the user malicious behavior suddenly get a rapid response in the trust model, thereby reducing the accumulation of bad user trust through small transactions and long-term integrity of the transaction in an enormous amount of carried out the possibility of fraud.

In addition, because trust is dynamic, but also need to introduce some malicious punishment mechanism to alert the user. In addition, the dynamic properties of the trust not only in the trust value of trading experience with the new update, but also in a long time when there is no trading experience, the trust should decay with time. in order to reflect the impact of the time factor and punishment mechanism of trust, we introduce time-sensitive functions, in order to better reflect the dynamic properties of trust.

The timeline is divided into a number of time windows,Length $t_0$, and each pass $|t_0|$ time, once attenuation.If $\text{Agent}_c$ join the trust transaction network time is $t_{\text{initial}}$, a trust evaluation of Agentp time t, $t > t_{\text{initial}}$, then the experience here in $k = \left\lfloor \frac{t - t_{initial}}{t_0} \right\rfloor$ time window, wherein, K is an integer order i (i=1,2 time window,... K), start time is $t_{\text{initial}\_i}$ ,the end time is $t_{\text{end}\_i}$ , the $\text{Agent}_c$ to $\text{Agent}_p$ in $t_{\text{initial}\_i}$ trust is $\tau_{t_{initial\_i}}$ ,in $t_{\text{end}\_i}$ , trust is $\tau_{t_{end\_i}}$ , time sensitive function can be defined as

$$sensitive(\tau_i) = \tau_{end\_i}\left(1 + \frac{\sum_{i=1}^{k} \tau_{end\_i} - \tau_{initial\_i} \big/ \tau_{initial\_i}}{k}\right), k = \left\lfloor \frac{t - t_{initial}}{t_0} \right\rfloor \tag{9}$$

Trust amended through type(11), both as a time window period t0 punishment mechanism, but also better reflect trust over time decay properties of no longer a new deal. Trust model will be compared with the cumulative punishment mechanism and time-sensitive factor separate ways, we use the time-sensitive function significantly reduces the computational complexity, and a better convergence.

## 4. Simulation Experiments and Results Analysis

(NetLogo is Northwestern University Center for Connected Learning (CCL) developed a programmable modeling environment is an open simulation platform to study the use of Multi-Agent-based simulation modeling of complex open systems thinking, with its own model library can be set according to a variety of conditions. According to the calculation method of the model, the use of the system between Agent continuous evolution over time, in order to gain the simulation data.）

### 4.1. Simulation Environment and Experimental Procedures

Select Taobao accumulated trust and averaging (no prevention technology) E-FIRE model [22] (Ref. [22] have demonstrated the, performance of E-FIRE FIRE model is better than the proposed model Huynh and SPORAS model proposed by Zacharia), currently identify and prevent malicious behavior better performance Travos model they

and our the network transaction trust (CFBC) simulation experiment results to the average mean square error as a standard for comparison.

The simulation environment has a user ($Agent_c$), 10 user ratings ($Agent_e$), 41 merchants ($Agent_p$). Among them, the score user ($Agent_e$) divided fair and unfair users, unfair users, divided into the following four categories: lying , noisy , badmouthing and bragging. We made simulation experiments respectively.

For 41 businesses, which provide good service in the real probability Pi [0,1] uniformly distributed, were set to [0,0.025,0.05, ..., 0.975,1]. Probability provided by a user reputation system estimated value $\hat{P}_i$ , then the reputation system performance can be measured ($N_p$ is the number of the merchant) by averaging the estimates and the true value of the mean square error between:

$$\Phi = \frac{1}{N_p}\sum_{i=1}^{N_p}(\mathrm{P}_i - \hat{P}_i)^2 \tag{10}$$

Simulation steps are as follows:

(1) System randomly selected one pair of scores $Agent_e$ users to interact with the business $Agent_p$, a total of 41 × 10 × 20 = 8200 times, that is ,the average score was 20 times the interaction between the user $Agent_e$ and each business $Agent_p$, to generate interaction history score user $Agent_e$ and business $Agent_p$. initialization loop variable i=1;

(2) The user $Agent_c$ query evaluation of each business $Agent_p$ each score users $Agent_e$;

(3) Score the user $Agent_e$ recording data in interactive history with the merchants $Agent_p$ as basis, structural evaluation in response to a user query in $Agent_c$;

(4) User $Agent_c$ according to the received evaluation, according to a malicious behavior prevention methods, estimation of each business $Agent_p$ reputation value;

(5) System in accordance with formula (42) obtained by the estimate of the mean square error of diameter $\Phi_i$;

(6) Users $Agent_c$ with each merchant $Agent_p$ have carried one interaction, and save the results interactively; i ++;

(7) If i <41, advances to step (2);

(8) End, the output for each of $\Phi_i$.

Each experiment will run 20 times, and taking the average value as the evaluation basis.

The experiment was divided into two cases, first cases focus on the security performance comparison system in kind environment (score users $Agent_e$ all honest) and malicious environment ( 50% Agente users to take to prevent malicious behavior); Second case, all scores user $Agent_e$ are taking bad behavior, while a user $Agent_c$ when calculating business reputation will join their direct experience. This part is in contrast to the robust performance of the user $Agent_c$ extreme environments-time model of the system.

### 4.2. Dynamic Update of Trust Environmental Integrity or Credibility of the System is 0.5 Probability for Malicious behavior Prevention Performance Test

Each experiment, the composition of the user Agente score as shown in Table 1, the experimental results shown in Figure 1 to 5.

 

**Table 1. Case 1 Score in Each Experiment the Number of Users**

| Appraise user $Agent_e$ type | Appraise user $Agent_e$ quantity | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| fair | 10 | 5 | 5 | 5 | 5 |
| lying | 0 | 5 | 0 | 0 | 0 |
| noisy | 0 | 0 | 5 | 0 | 0 |
| badmouthing | 0 | 0 | 0 | 5 | 0 |
| bragging | 0 | 0 | 0 | 0 | 5 |

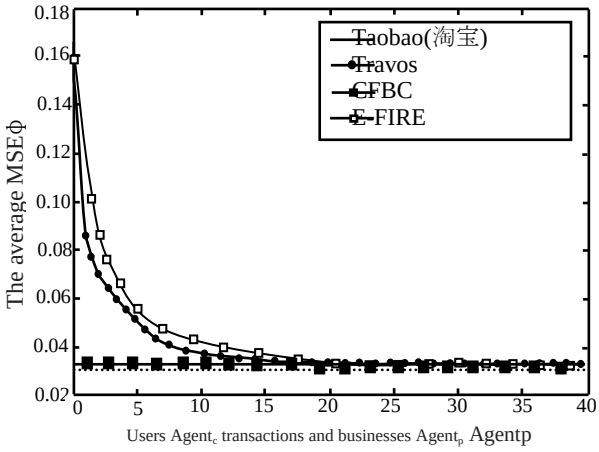


**Figure 1. In the Integrity of Trusted Computing Model Diagram Score Users**

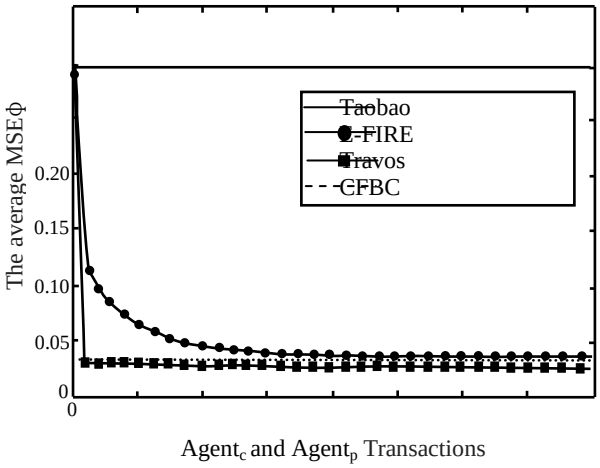


**Figure 2. Pairs of 50% of Rated Performance Lying Malicious User to Take Preventive Behavior Comparison**

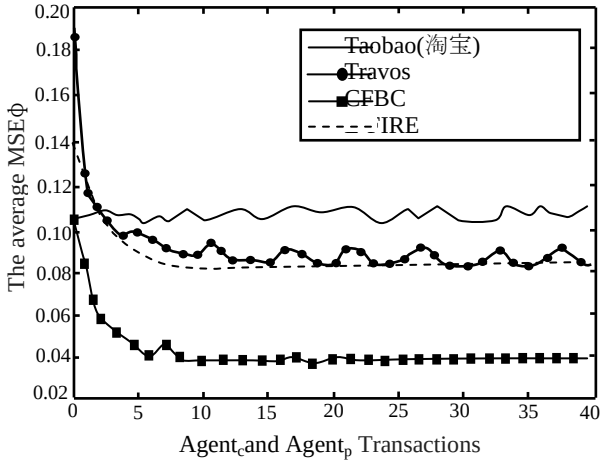


**Figure 3. Pairs 50% of Rated Users to Take Precautions Performance Comparison Noisy Malicious Behavior**

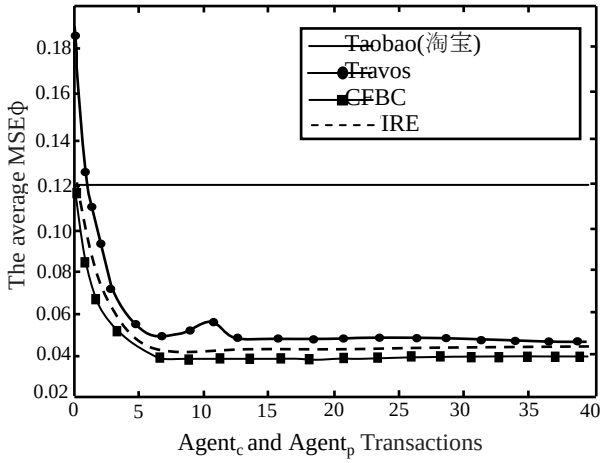


**Figure 4. Pairs of 50% of Rated Performance Badmouthing Users to Take Preventive Behaviors Compare**

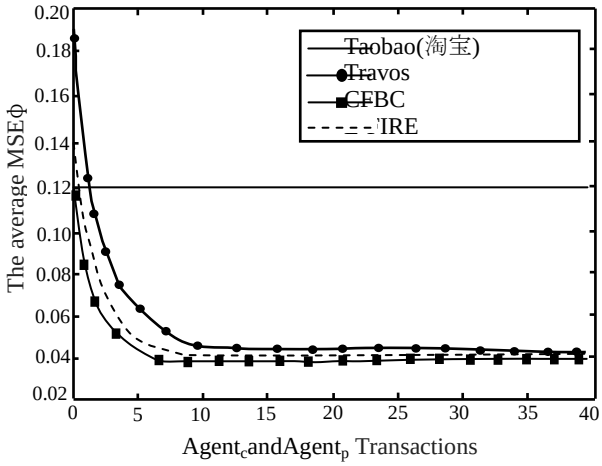


**Figure 5. Pairs of 50% of Rated Performance Bragging users to Take Preventive Behaviors Compare**

 

As can be seen from Figure 2, when the 10 $Agent_e$ integrity are fair, Taobao system due to all $Agent_e$ are considered fully credible, without introducing errors, can be considered the theoretical optimal value, the mean square error is minimized; In this paper, a model system average mean square error curve substantially coincident with Taobao, showing filtration and prevent system this model basically no adverse effect on the fair user $Agent_c$, ie malicious users $Agent_e$ the minimum error rate; In Travos system, when fewer transactions between $Agent_c$ and $Agent_p$, because cannot verify whether $Agent_e$ trustworthy, so the most $Agent_e$ rating mistakenly filtered out, with the number of interactions between the $Agent_c$ and $Agent_p$ increase the impact of this error will gradually decrease, while the number of transactions reached 20 later, this effect was basically eliminated.

When there are various types of malicious users $Agent_e$, Figures 3 to 6, respectively, compared the effect of filtering and prevention systems, and can be seen from the figure, no risk prevention and filtering technology Taobao system, the calculated value of the real credibility large difference between the values, namely the existence of a malicious user $Agent_e$ will seriously affect the usability of the system. Travos, E-FIRE and this model system to filter and prevent malicious behavior effects are very obvious, can significantly improve system availability.

When the history of transactions N between $Agent_c$ and $Agent_p$ long enough (30 to 40), both for the evaluation of various false and malicious attacks significantly filtering and prevention effects. In this paper, but the average mean square error of the trust system common than Travos and E-FIRE trust system is much smaller. Travos system attack prevention effect noisy type user $Agent_e$ poor.

When the history of interaction N between $Agent_c$ and $Agent_p$ times less time (1~10), Taobao and the Travos model than the average mean square error was significantly decreased, E-FIRE and Travos close. For network online transactions, since the actual environment less history of transactions between buyers and sellers, so this comparison of more practical value.

## 5. Conclusions and Further Work

The second and following pages should begin 1.0 inch (2.54 cm) from the top edge. On all pages, the bottom margin should be 1-3/16 inches (2.86 cm) from the bottom edge of the page for 8.5 x 11-inch paper; for A4 paper, approximately 1-5/8 inches (4.13 cm) from the bottom edge of the page. In an open virtual electronic market, build and evaluate the trust relationship between entities is to solve one of its trading transaction security control mechanisms of the most effective methods. Based on the lack of an existing network of trust transaction management mechanism on the basis of the analysis, particularly in view of the current mobile Internet trading problems of trust model, we propose a dynamic trust transaction security mechanisms based on Multi-Agent Systems. The main contribution of this work are: (1) introducing transaction time, the number of transactions, transaction price,and other important factors of transactions, to solve the existing model is difficult to accurately foresee the transaction, distinguish the user's behavior problems; (2) To solve many of the current model ignores the transaction rater reliability of the test itself, can effectively filter and remove credit squeeze, libel or other effects on the credibility of the transaction trust malicious behavior problems; (3) In this paper, the multi-dimensional nature of trust, failed to reflect and embody the overall credibility of the transaction the user, the solution to the traditional methods can not implement a personalized assessment of the user questions; (4) the introduction of malicious behavior prevention and punishment mechanism to solve the trust model is vulnerable to malicious attack behavior problems and improve the robustness of the trust model; (5) In addition, research in the field of mobile multi-

Agent system, deepen the Jennings, who trust on Multi-Agent Systems work, the model has a more robust dynamic adaptability.

The next step, focused on: Combined with the mobile Internet mobile commerce transactions ideological characteristics and virtual social networks, cloud computing and mobile Agent collaborative filtering technology, structure-based personalized dynamic trust calculation model is recommended. The work is one of our core research content of the National Natural Science Foundation of China (cloud computing environments Mobile Agent System trusted security key technology research, 61472136), the establishment of the model will have a very good complementary and this model will be further perfect mobile Internet online transaction security mechanisms, and promote the healthy development of mobile commerce.

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## References

[1] CNNIC. The size of the smart phone users reached 480 million. China Mobile Internet Research Reports,http://www.techweb.com.cn/data/2014-08-26/2069006.shtml 2014.8
[2] Nan H,Ling L,Vallabh Sambamurthy. Fraud detection in online consumer reviews[J]. Decision Support Systems,2011,50(3): 614–626
[3] Zhang Z Q,Xie X Q et al.. CRank: A Credit Assessment Model in C2C e-Commerce[J]. Information Systems Development,2011,5: 333-343
[4] Yan Yun. C2C transactions in the dynamic credit evaluation model. Information Science,2010,28(4): 563-566]
[5] McCole P.,Ramsey E.,Williams J. Trust considerations on attitudes towards online purchasing: The moderating effect of privacy and security concerns[J]. Journal of Business Research,2010,63(9/10): 1018–1024
[6] Yaghoubi N. Trust Models in e-Business: Analytical-Compare Approach[J]. Interdisciplinary Journal of Contemporary Research in Business,2011,2(9): 398-416
[7] Zhang Xiaojie. A strengthening of security solutions C2C transaction integrity. Microelectronics & Computer,2010,27(5): 194-198
[8] Marsh S. Formalising trust as a computational concept[D]. Ph.D. Thesis,1994,University of Stirling
[9] Blaze M,Feigenbaum J,Lacy J. Decentralized trust management//Proceedings of the Symposium on Security and Privacy. Oakland,1996: 164-173
[10] Blaze M,Feigenbaum J,Keromytis A D. Keynote: Trust management for public-key infrastructures// Proceedings of the1998 Security Protocols International Workshop,Cambridge,England,1998: 59-63
[11] Griffiths N. Task delegation using experience based multi-dimensional trust. In: Proc. of the 4th Int'l Joint Conf. on Autonomous Agents and Multiagent Systems. Netherlands: ACM Press,2005. 489−496. [doi: 10.1145/1082473.1082548]
[12] Zhang Q,Zhang X,Wen XZ,Liu JR,Ting S. Construction of peer-to-peer multiple-grain trust model. Journal of Software,2006,17(1):96−107 (in Chinese with English abstract). http://www.jos.org.cn/1000-9825/17/ 96.htm [doi: 10.1360/jos170096]
[13] Wang XS,Liang P,Ma HD,Xing D,Wang BZ. A P2P trust model based on multi-dimensional trust evaluation. In: Proc. of the Bio-Inspired Computational Intelligence and Applications,Vol.4688. Heidelberg,Berlin: Springer-Verlag,2007. 347−356. [doi: 10.1007/978-3-540-74769-7_38]
[14] Guo LT,Yang SB,Wang J,Zhou JY. Trust model based on similarity measure of vector in P2P networks. In: Zhuge H,Fox GC,eds. Proc. of the GCC 2005. LNCS 3795,Heidelberg,Berlin: Springer-Verlag,2005. 836−847. [doi: 10.1007/11590354_103]
[15] Reece S,Rogers A,Roberts S,Jennings NR. Rumours and reputation: Evaluating multi-dimensional trust within a decentralized reputation system. In: Proc. of the 6th Int'l Joint Conf. on Autonomous Agents and Multiagent Systems. Honolulu: ACM Press,2007. 1−8. [doi: 10.1145/1329125.1329326]
[16] Reece S,Roberts S,Rogers A,Jennings NR. A multi-dimensional trust model for heterogeneous contract observations. In: Proc. of the 22th AAAI Conf. on Artificial Intelligence. London: AAAI Press,2007. 128−135
[17] Wang ShouXin,Zhang Li,Li He Song. Evaluation approach of subjective trust based on cloud model. Journal of Software,2010,21(6):1341-1352

 

[18] Shao K,Luo F,Mei NX,Liu ZT. Normal distribution based dynamical recommendation trust model. Journal of Software,2012,23(12):3130−3148 (in Chinese). http://www.jos.org.cn/1000-9825/4204.htm
[19] Teacy W T,Patel J,Jennings N R,Luck M. TRAVOS: Trust and reputation in the context of inaccurate information sources. Autonomous Agents and Multi Agent Systems,2006,12(2):183-198
[20] Shan M H,Gong J W,Niu E L,et al. RulerRep: Filtering out inaccurate ratings in reputation systems based on departure degree. Chinese journal of computers,,2010,33(7): 1226-1235
[21] Huynh T D,Jennings N R,Shadbolt N R. An integrated trust and reputation model for open multi-agent systems[J]. Autonomous agents and multi-agent systems,2006,13(2): 119-154
[22] Zhao Xiang,Huang Houkuan,Dong Xingye,et al. Atrust and reputataion system model for open multi-agent system. Journal of computer research and development,2009,46(9): 1480-1487
[23] Sabater J,Sierra C. REGRET: Reputation in gregarious societies. In: Proc. of the 15th Int'l Conf. on Autonomous Agents. New York: ACM Press,2001. 194−195. [doi: 10.1145/375735.376110]
[24] Sabater J,Sierra C. Reputation and social network analysis in multi-agent systems. In: Proc. of the 1st Int'l Joint Conf. on Autonomous Agents and Multi-Agent Systems. Bologna: ACM Press,2002. 475−482. [doi: 10.1145/544741.544854]
[25] Zhang Jie. C2C e-commerce trust evaluation model based on cloud model. Computer Systems & Applications,2010,19(11): 83-88
[26] Gan Z B,Zeng C,Li K,et al. Constrction and optimization of trust network in e-commerce environment. Chinese Journal of computers,2012,35(1): 27-37
[27] Gan Z B,Ding Q,Li K, et al. Reputation-Based Multi-Dimensional Trust Algorithm. Journal of software,2011,22(10),2401-2411
[28] Tong Xiangrong,Huang Houkuan,Zhang Wei. Prediction and abnormal behavior detection of agent dynamic interaction trust. Journal of computer research and development,2009,46(8): 1364-1370
[29] Zhang S B,Xu C X. Study on the trust evaluation approach based on cloud model. Chinese journal of compute,2013,36(2):422-431
[30] Fan LiJie,Wang SuZhen,Liu Wei. Evaluation method Based on human trust mechanism for mobile-commerce trust.ComputerScience,2012,39(1):190-193
[31] Jiang Weijin, Zhong Luo, Zhang Lianmei & Shi Dejia. Multi-Agent model based on dynamic collaborative activities in a logical sequence of complex systems. Chinese Journal of Computers, 2013,36(5): 1115-1124 (in Chinese with English abstract). [蒋伟进, 钟珞, 张莲梅, 史德嘉. 基于时序活动逻辑的复杂系统多Agent动态协作模型. 计算机学报, 2013, 36(5): 1115-1124]
[32] Jiang Weijin. Dynamic modeling and quantification trust more research methods Agent. Beijin: Science press,2014.6
[33] Jiang W J,Zhang L M,Wang P. Research on Grid Resource Scheduling Algorithm Based on MAS Coop- erative Bidding Game. Chinese Science F,2009,52(8): 1302-1320
[34] Jiang W J,Zhang L M,Wang P. Dynamic optimized dispatching model of computation resources based-on MAS cooperative mechanism. Sci Sin Inform,2009,39: 977–989
[35] Jiang W J,Zhong L,Zhang L M,Shi D J. Dynamic cooperative multi-agent model of complex system based-on sequential action' logic. Chinese journal of computers,2013,36(5): 115-1124
[36] Jiang Weijin,Xu Yuhui,Zhang Lianmei. Dynamic evolution model reuse complex knowledge-based component technology MAS. Systems Engineering Theory and Practice,2013,33(10): 2663-2673
[37] Jiang Weijin,Xu Yusheng,Guo Hong,Zhang Lianmei. Multi agent system-based dynamic trust calculation model and credit management mechanism of online trading. Science China: Information science,2014,44(9): 1084–1101,doi:10.1360/N112013-00202)
[38] Wang H M,Tang Y B,Yin G,et al. Trustworthiness of Internet-based software. Sci China Ser-F: Inf Sci,2006,36(10): 1156-1169
[39] Wang H M,Yin G,Xie B,et al. Research on network-based large-scale collaborative development and evolution of trustworthy software. Sci Sin Inform,2014,44: 1–19
[40] Xu J,Si G N,Yang J F,et al. An internetware dependable entity model and trust measurement based on evaluation. Sci Sin Inform,2013,43: 108–125
[41] Wang Jiafang,Feng Zhiyong,Xucao,Xu,Guangquan. Research on trust framework in multi-agent system from the cognitive view. Chinese journal of computers,2010(33): 139-151
[42] Shen C X,Zhang H G,Wang H M,et al. Research on trusted computing and its development. Sci China Inf Sci,2010,40(2): 139-166
[43] Chen H,Sun J H,Liu C,et al. A light-weight,secure and trusted virtual execution environment. Sci Sin Inform,2012,42(5): 617–633
[44] Li L H,Zhang J P,Yang J. Based time-series aware of social network nodes set context aggregation method. Sci Sin Inform,2013,43: 1079–1095

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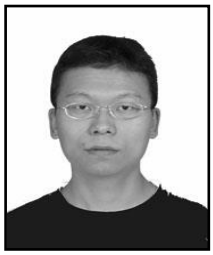

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