Multi agent based Web Reputation System

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***Abstract*— In this research work, we have proposed a new multi agent based architecture for reputation system that will be intelligent enough for improving the quality of websites, its ranking and eventually it will increase the trust worthiness of the website. The data collected will be stored in the data warehouse where the business analytics can access the data and carryout the various analyses and give their feedback in order to increase the overall website efficiency. This feedback will be a basis for planning improvements of the web application supporting the respective websites that are being analyzed.**

***Index Terms*— data warehouse, e-commerce, multi agent system (MAS), trust worthiness.**

I. INTRODUCTION

During the yesteryears of Internet and World Wide Web, when the websites were mostly static, the trustworthiness among the people was not a major concern, since the people (users) were divided into small groups and their access levels, usage requirements and goals as well were same. And in further and more recent years, due to the influx of numerous social networking and data driven websites, people (users) are able to maintain their trust up to some context only. The significance of trustworthiness plays a key role in current era internet websites due to volume and type of information, a user stores or maintains over the web. The information that is uploaded over the web could be personal or business oriented and when used by unauthorized users in fraudulent and illegal manner may harm the reputation of an individual or business organization. So, now with the advent of critical information being present over the web, an unexplainable need for a reputation system that reports the credibility of any website has inadvertently arisen and it is obvious.

Reputation Systems has multiple definitions when explained by many authors in varying contextual typeset. Few authors have defined it as; an important tool which helps in reducing the risk of transaction [1]. In another way the Reputation System is defined; as a valuable tool to establish trust worthy relationships between various transactional users such as buyers and sellers [2]. Reputation System is an "expectation about an agent's behavior built on the evidence or information about his/her past activities". An individual's personal trust can be derived from the aggregated and personal experience [3]. Reputation plays a pivotal role by enabling multiple parties to establish relationships that achieve mutual benefit. In general, reputation is the opinion of the public towards a person, an organization, a group of people or a resource.

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E-Commerce has paved away for novel business opportunities but introduces risks to traders as there is no face to face interaction among the sellers and buyers and also does not possess mutual information needed for risk evaluation. In traditional business, the buyers judge the quality of product by their direct observation while in e-commerce the product might not be as good as it was described by the sellers. In this fast paced era, in order to save the time for its stakeholders; most of the companies have put their transactions online and also the purchase of goods has increased online due to which there is a high need to have stable system that can report the trust worthiness and reliability of the e-commerce website to the users. Relying just on the past historical transactions or feedback does not entirely determine a sites trustworthiness. This Web based Reputation System will serve as a basis for web intelligence in the world of 3.0 technologies.

We propose an analytical framework by which reputation systems can be decomposed, analyzed, and compared using a common set of metrics. This framework facilitates insights into the strengths and weaknesses of different systems and comparisons within a unified framework.

The paper is organized into five sections including Introduction Section. Section II discusses about related works, multi agent is discussed in Section III, Section IV explains the proposed Framework for reputation system and Section V shows the algorithm for the reputation system.

II. RELATED WORKS

In this current era of information and communication technology, the e-commerce industry has attained an inevitable role. Various e-commerce websites are getting different groups of customers at every instant of time. They get massive amount of business day to day. They have different methods for gaining confidence of their customers by statistics such as star rating, client reviews from online customers to get massive amount of exposure. In all these years, the reputation system is a kind of application that play an important role in increasing web businesses. Trust plays a crucial role for online transaction and processes. Reputation System is a valuable tool that establish the trusty worthy relationship among its users. It is used to judge what is good and what is bad. It is an expectation about a user behaviour built on the evidence of his/her past historical transactions. Starting from Scientometrics, the study of measuring research output up to current artificial decision making, several researchers presented their idea about reputation system.

Jie Wang [2010] presented a coherent adaptive model to measure the trust worthiness of peers in e-commerce system. The evaluation is done using the transaction feedback between the peers. Rating provided by the peer to the reference peer plays an important vital role in the evaluation

process for trust worthiness [4]. The presented model fulfills the demand for structured P2P overlay network and not for unstructured network. Lie Yanbin [2009] proposed a secure reputation system that generates an anonymous identity for the feedback provider to provide their rating for the feedback target [5]. This reduces the threats of masquerading of identity; also provide a privacy of feedback target and feedback provider. Since the system uses smart card for generating secret identity key, it is quite difficult for using this kind of reputation system. Rehab Alner[2011] describe a semantic web technologies based model to facilitate reputation knowledge transfer on the communication level. It explains the two hypotheses based on which an online survey was setup. The user was asked different question to capture how they perceive online rating and what information help them to make their decision of selecting a service provider. Although, the paper explained that the users make more use of reputation information than the one being represented in current formats [6]. However, there is no significant use of this model in helping the service provider for predicting the user buying decision or utilizing their service. Hasen Nicanfar[2013] suggested a system for assessing the trust for the service delivered by cloud service provider. Hasen also proposed an application for selecting the best service provider by different cloud consumer by minimizing the cost and maximizing the faith for its users. The proposed cloud based system was showed secure and reliable but still the cost of the system was too much and hence further it was planned to add cost minimization approach to increase the efficiency of the algorithm [8].

III. Multi Agent

Agent technology is one of the most emerging technologies that boom in the current era of distributed collaborative environment [7]. The technology makes use of multi agents, which are nothing but are simple programs that perform some task. The agents are enough smart to make decision according to the situation arise. They are volatile in nature, can enter any environment and have the capability to adopt and deal with new environment.

In e-commerce environment agents are used by the user to search web resources more directly. Agents in e-commerce business offers personalized customer service without buyers and seller's interaction. Agents are intelligent and learn about the customer behavior overtime by recording preferences, make some improvement on itself and offer better services to its customer in the future. Collaborative behavior, Social ability, proactive and reactive properties of agents makes them to suit our Reputation System environment. The proposed framework is built around multi agent system that uses four types of agents:

A1: Security agent- It resolves the issues related to security. It is available at the user interface level and introduces all types of URL verification, encryption, authentication and authorization.

A2: Collector agent- This agent is responsible for collecting information from the targeted websites and may communicate with collaborative agent as per its need.

A3: Decision making agent- This agent is very smart to analyze the group of datasets and make its decision about the reputation of the system.

A4: Collaborative agent- The collaborative agent is responsible for inter process communication based on analytical ability to make decision on the feedback from all three agents.

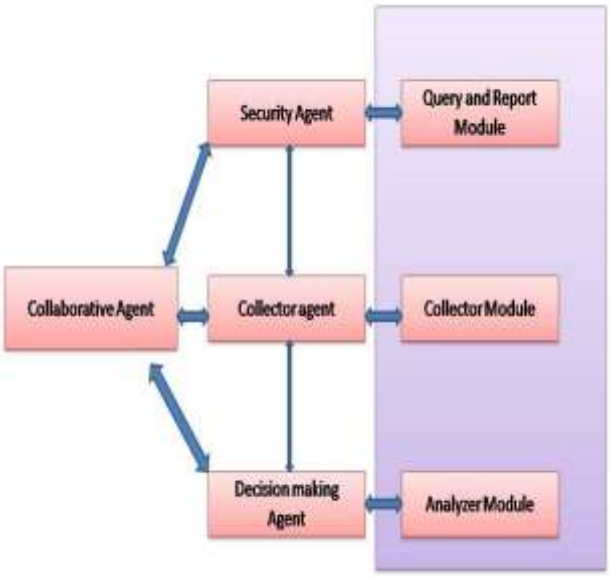

Fig 1: Multi agent System

IV. Proposed Framework

A good framework can be achieved if we adopt divided modules; so that each module can perform a specific task with the support of their agents and fulfill the need of the system from the information available in the database. Reputation system is implemented as a web browser plugin, similar to any search engine tool bar which will be embedded in Mozilla Firefox's code and will correlate with the user's requirement. The system is developed in Java Server Pages (JSP) that is running on JBOSS Application Server and use MySQL database Server at the backend. The application is deployed over Amazon EC2 virtual machine that is located on the cloud provided by Amazon. It is cost effective and available 24X7 with nearly zero maintenance cost. In this framework we proposed multi agent based three modules architecture, the modules are as follows:

a) Collector module

b) Analyzer module

c) Query and report module

As shown below, each module will collect few significant parameters and work with different mechanism to give the neighbor module the proper result with the help of their intelligent agent. The information is transferred across the module using RSA encryption algorithm that uses secret decryption key and common public key.

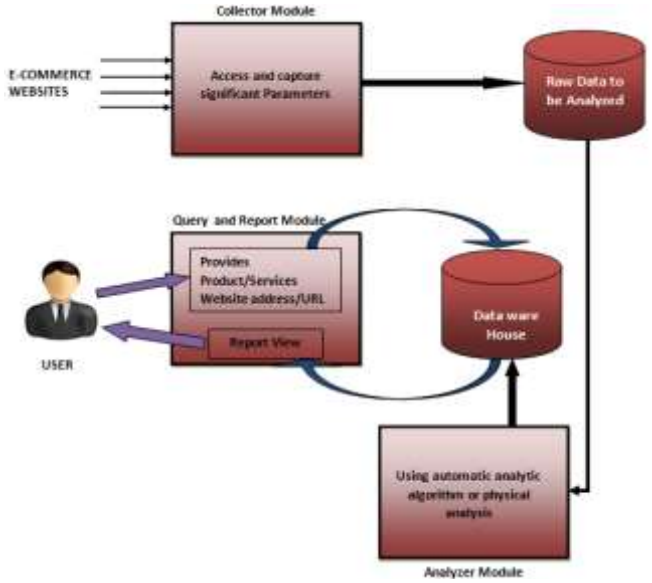

Fig. 2: Reputation System Framework

4.1 Collector Module:

This module involves the collaboration of security agent A1 for the user's authentication. Several intelligent agents are injected to collect various specific information from the target website(s). This captured information will serve as the core of the reputation system, and the reputation system results will be based on the assessment of the same information.

The wrong or fraudulent information must be filtered out from captured information that may be impacted by the feedback that may have been provided by the costumer or the service provider. Since the costumer can cheat the system by flooding fake ratings and negatively affect the reputation of service provider. Service provider can cheat the costumer by fake numbers or create fake customers to provide fake ratings. To avoid all of this we must consider a system that does not involve the costumer or service provider's feedback. And all gathered information must be independent from any human interception and must be fully automated.

The information collected is as follows:

4.1.1 Volume of Transactions: Volume of transactions is critical parameter as it can measure and judge the behavior of service provider. For example, when you have two websites, one of them has completed 100 transactions, and you have another website where, 100,000 transactions have been completed. By comparing these two numbers the costumer will choose the second one with more number of transactions; the reason for this seems obvious as it's more reliable and efficient than the later.

Under the "Volume of transactions" parameter, evolve a few sub parameters, or rules, that help in organizing and clarifying the meaning of this term.

These sub parameters or rules are follows:

4.1.1.1 Time Span: Time Span can judge the behavior of the system fairly appropriately. For example, let us consider that there exist two websites, the first website has 1000 transaction in less than a year time span, and the second website processes 1000 transactions within an approximate eight-month period. These two websites now have the same volume of transactions; the only difference exists in these two websites is the second one has achieved this in a short time span as compared to the first one. This makes the one with the shortest time more reliable and more trust worthy than the other one with longer time span.

4.1.1.2 Demographic Information (DI): The geographical location where the service is being utilized can affect the purpose and the efficiency to the judge the reputation system in a certain way. For example, there is a website with 5000 transactions completed within period of one year; this website is providing its services across the globe, when you compare this number to the wider target area this appears to be small. When this service targets a local area, for example within a country, it is considered more reliable and trust worthy as the target region will have appropriate number of transactions.

4.1.1.3 Intrinsic Quality: Website intrinsic quality is another parameter that assesses the level of data for a website and effect the usage of that website. Putting too much data over the webpage reduce the user's degree of satisfaction. Consider a case, a website with unnecessary pictures and videos takes more time to load the webpage contents as compared to the website that have only valuable information.

4.1.2 Digital Certificate: Digital Certificate which is an electronic credential is important parameter to verify the identity of the websites and to ensure content integrity. It provides an encrypted channel for secure transaction. Secure Socket Layer (SSL) protocol is used to access the digital certificate information. Digital certificate is very significant as it is the basis for trust.

Digital Certificate comprises of the following sub parameters:

4.1.2.1 Validity: We need to check the expiry date of the digital certificate. After its validity, digital certificate does not have any value and hence cannot be taken into consideration for proving the trust worthiness.

4.1.2.2 Issuing Authority: If the author of the digital certificate is unreliable then the digital certificate will not be authentic.

4.1.2.3 Digital Signature of Issuing Authority: The digital signature must contain the digital signature information of the issuing authority. Few of the issuing authorities do not embed its digital signature within the digital certificate. This decreases the trust of clients for this particular issuing authority.

4.1.2.4 Period of Use: It is the duration for how long the client has been using the digital certificate. If the period of use is long, it is considered as trusty website as compared with the one having less duration of the same.

4.1.2.5 Frequency of renewal: Frequency of the renewal from the first use of digital certificate. It counts the number of times; the clients change their digital certificate issuing authority.

4.1.3 Cost of Transactions: Each entity the service provider provides has a certain cost, for example the service provider provides two entities, one has 1000 USD cost and the other has 100 USD cost, the weight of the transaction of the entity with 1000 USD is higher than the transaction of entity with 100 USD. The transaction with higher weight is a positive indicator of more usage of that particular website and gives an evidence of good reputation.

4.1.4 Service Unavailability: If the service shut down frequently, it reduces the performance of the system. If the system cannot be reached when it is needed, the reputation will be low.

4.1.5 Fairness: It is the rate of satisfaction of users or we can say it social efficiency that is based on number of contracts honored. A good reputation system must discourage cheating and encourage completing the transaction with satisfaction of both parties.

4.2 Analyzer Module:

The inputs to this module come from raw data storage, which contains the original information to be analyzed. The analyzer will fetch the information and do the checking and the calculations on it in order to calculate the final result for the reputation system. The result of this module will be stored in data ware house. The data ware house works as the intermediate storage between the analyzer module and the query and report module.

4.3 Query and Report Module:

This module is the nearest module to the end user. The end user will get the final result of the reputation system here. The module provides a user friendly interface to its client. The user's request result is displayed by this module in the scale of 1-5; the end user will translate it to how much this service provider is reliable or trusted.

V. METHODOLOGY

The study is focusing on calculating the reputation of e-commerce websites. Considering the reputation is calculated for a number of websites. Our approach is to setup the initial value for every website and updating the reputation based on various parameters for every one week. The parameter VolumeofTransaction is take into consideration for setting up the initial value for the reputation. The value of reputation is updated based on three parameters which are total number transaction, cost of transaction and time span for a period of one week.

Agent A1 is a security agent that verify the URL of the websites. Agent A2 is a collector agent that collect information from various websites. setInitialRepu( ) function is called to assign the initial value 0 to the reputation variable R for the e-commerce websites. The value of reputation get update depending on the number of transaction within a period of one week. setInitialRepu_cost( ) function update the reputation depending on the variable thresholdamount, if totalTranscationAmtW of a website is greater than the thresholdamount value, the value of reputation will increase by 0.1 otherwise it will decrease by 0.1. setInitialRepu_Timespan( ) function update the value of reputation depending on the variable TransactionTimeWebsite (TTW). TTW is the time taken by the website for fixed number of transactions that is TransactionThreshold(TT). Assuming the value of TT to be 1000. If the values of TTW of first website is smaller than the value of TTW of second website than the reputation value of first website is good which will be increased by 0.1.

```
If (URLVerified)
{
    switch (Agent [A1])                          //Shift to Security Agent
    {
    global R[1..n] ;                             // n is number of website
        //Volume of transaction
        setInitialRepu( )
        {
        switch (Agent [A2])                      //Shift to Collector Agent
        {
            for(i=1; i<=n ; i++){
            //Read all transactions of Agent [A2];
            VolumeofTransactionW[i]=∑ (TransactionW[i](Agent [A2]));
            R[i]=0;                                          //Assume
            // VolumeofTransactionW[i]= VTW[i];
            if(VTW[i]> 500,000  and VTW[i] < 1,000,000 )          //Assume
            R[i] = R[i] +1 ;
            else if(VTW[i] > 1000,000  and VTW[i]< 1,500,000 )
            R[i] = R[i] +1.5 ;
            else if(VTW[i] > 1,500,000  and VTW[i] < 2,000,000 )
            R[i] = R[i] +2.0;
            .....
                        // ceiling value of reputation is assumed to be 5
            }
        }
        }
    //Cost of transaction:
    setInitialRepu_cost( )
    {
    switch (Agent [A2])
    {
        for (i=1; i<=n; i++)
        {
        //Scan the transaction log file of Agent [A2];
        totalTranscationAmtW[i]=∑ (transcationAmtW[i](Agent [A2]));
        int thresholdamount = 1000;
        if (totalTranscationAmtW[i] >=thresholdamount) {
        R[i] = R[i] + 0.1;
        }
        else{
        R[i] = R[i] - 0.1;
        }
        }
    }
    }
        //Time Span:
        setInitialRepu_Timespan( )
        {
        switch (Agent [A2])
        {
            TT= 1000;              //TransactionThreshold
            for(i=1; i<=n; i++)
            {
            if(TTW[i] < TTW[i+1])  //TransactionTimeWebsite
            {
            bestTime= TTW[i];
            bestWebsite = i;
            }
            }
            R[bestWebsite]=R[bestWebsite] + 0.1;
        }
        }
        }
    }
else {
print "Invalid URL, reputation cannot be determined";
}
```

Algorithm: Reputation of e-commerce websites

VI. CONCLUSION

This paper presents a framework of an agent enabled reputation system and implemented its algorithm for a multi-agent environment. The collector module provides a user friendly interface which help user to send query and elicit its result provided by the smart analyzer module by using intelligent agent A2. An Algorithm of the proposed framework was implemented using Java Servlets and Java Server Pages and was validated by using beta e-commerce websites.

The future work is to include more measuring parameters like digital certificate, intrinsic quality of the websites, service unavailability etc. for calculating better reputation of the system.

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