

# Review Spamicity Approach on Customer Score

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## ABSTRACT:-

Understanding the content of the review from the reviewers relating to particular product, is the key concept being expressed. Subsequently, websites containing customer reviews are becoming targets of opinion spam. It is important to detect opinion spam to enable the real opinion of the product to surface. Hence, we propose an efficient and effective Semantic technique, SentiWordNet lexicon and a tool, Word Count and a method known as Counting method, to find spamicity of the reviews based on the content and rating of the reviews. The experimental results shows that the proposed technique has comparatively effective spamicity detection than other technique based on the rating and content of the reviews.

**Keywords-** Review spam, Opinion mining, Sentiment analysis, SentiWordNet, Word Count.

## I. INTRODUCTION

The ubiquity of web2.0 makes the web an invaluable source of information. For instance, product reviews composed collaboratively by many independent internet reviewers can help consumers make purchase decisions and enable enterprises to improve their business. These users are referred to as sock puppets. Each category of spammers presents its own exactitudes and this makes it very difficult, if not impossible for researchers to design a catch-all model[1]. Online reviews are generically different from classic survey data and data gathered from questionnaires or interviews .One can now post reviews of a product at merchant sites and express their views and interact with others via blogs and forums. Spammers publish spurious reviews to promote or demote target online store [2]. These opinions are helpful for both business organizations and individuals. Spam reviews undoubtedly reduce the quality of reviews [3,4,5]. Spam reviews are generated by automatically posting random comments or by hiring people to write undeserving positive or negative reviews. Opinion spam can range from annoying self-promotion of an unrelated website or blog to deliberate review fraud. Rating is regarded as representation of reviewers sentiment orientation. Compared with rating score, the content of the reviews will represent more accurate sentiment of the reviewer. This paper is incorporating sentiment analysis techniques into spam review detection .Linguistic tool known as Word Count is used in this work, it counts the number of words in a review. Counting method is used to find positive and negative opinion words. Words in a review are tokenized; stop words are filtered from the reviews. SentiWordNet is assigned to describe how positive and negative the terms contained in the review text are, next we calculate rating computed based on the content of the review(MR) by considering the content of the reviews, for the reviews, from the stores (Dhgate.com and Neweggs.com) as depicted in Algorithm1. Rating computed based on the content of the review are compared with that of rating given by the

reviewers(AR) and difference between the ratings  $|AR-MR|$  is in Algorithm 2. The present paper discusses about the trends of detection of review spam with respect to mining contents in customer reviews. Section 2 introduces about the related work. Section 3 gives an overview about reviews extracted from review website and proposed technique of customer review of spam detection. Section 4 describes the working and experimental results for detecting review spam. Section 5 presents our conclusion and future work.

## II. RELATED WORK

In [15] it gives a web mining taxonomy but restricted to web content and web usage mining and gives a survey on web usage mining. It divides the web content mining into the agent based approach and the database approach By analyzing several million reviews from the popular Amazon.com. In [7] used a bag-of-words approach and calculated the frequency of certain words from the review text. They then classified some reviews as suspicious if the text contained a high number of predefined suspicious words. In [8] they cast the problem of ranking reviews in a supervised learning framework, and showed impressive results. In [9] proposes the method for untruthful review spam detection using text mining model and integrated into semantic language model and non-review spam detection. Conceptual level similarity measure used for detecting spam reviews based on the product features is proposed in [10]. In [11] proposes the review graph to show the relationship among reviewers, reviews and store that reviewer has reviewed. In [12] a recent work in review spam detection is concerned with a problem of singleton review. In [13] observed that the vast majority of reviewers more than 90% in their study of resellerratings.com reviews upto 2010 only write one review. In [14] concentrated on detecting spammer groups who write the reviews on the different product. Our method aims at extracting the reviews from review website resellerratings.com for different stores and based on reviewer behavior/opinion (semantic analysis),

analyze the content of the reviews as positive and negative, and find review spamicity based on content and rating of reviews. The experimental results demonstrate the effectiveness of the proposed technique.

### III. PROPOSED TECHNIQUE

We propose a novel and effective technique to detect spam reviews based on the content text of the reviews and the ratings of the reviewers. The idea is based on mining review content from review website resellarratings.com in customer reviews from two stores and to find the spamicity of the reviews. Review and rating behaviors such as similarity, deviation and good or bad review are considered to detect spamicity [15]. The various steps of the proposed method include:

- Review Extractor
- Review analysis using Semantic approach
- Sentiment word orientation
- Sentiment polarity.
- Review spamicity based on rank and content of the review.
- Experimental results

#### Review Extractor

Reviews are extracted from review website www.resellarratings.com for the stores Dhgate.com and Neweggs.com using review extractor tool (import.io). The extracted reviews are stored in raw review database.

#### Review analysis using Semantic c approach

Extracted reviews are taken from review database. From the review database, tokenization process is carried to each review word i.e. the review text is split into simple tokens such as numbers, punctuation and words of different types. Later stop words are filtered out from the reviews, to improve efficiency and to help reduce indexing file size of the reviews. Three examples, reviews are taken from a store neweggs.com, 1.“Good customer support through chat”, there are total five words, out of which one is a stop word (through) and remaining four words are (good customer support chat). Similarly for the review 2.” I had a problem involving my bank stopping a payment due to suspicion of fraud” there are total fifteen words, eight are stop words ( i , had , a , my , a , due to , of ) remaining seven words are ( problem involving bank stopping payment suspicion fraud). 3.“Generally decent prices - but buyer beware. Many of the lower priced products/specials are items with a high percentage of poor reviews/performance. Service and return policies usually good but shipping can be a problem. If you need it fast order it elsewhere. Not unusual to take a week or more” it consists of fifty words, twenty three are stop words ( but , many , of , the , are , with , a , of , and , but , can , be , a , if , you , it , elsewhere , not , to , it , a , or , more ) remaining twenty seven words are ( Generally decent prices - buyer beware lower priced products/specials items high percentage poor reviews/performance service return policies usually good shipping problem need fast order unusual take week) Word Count tool is used to count number of words in a review. Further these reviews are stored in opinion analyzed database.

#### Sentiment Word Orientation

Reviews from opinion analyzed database will become an input to this step. For these reviews, positive and negative words are measured using SentiWordNet. The predefined opinion words are taken from a dictionary as positive and negative words and are stored in a separated file. Few examples of reviews taken from a store, neweggs.com (after removing stop words) 1.“Good customer support chat”, 2. “Problem involving bank stopping payment suspicion fraud”, 3.”Generally decent prices buyer beware lower priced products/specials items high percentage poor reviews/performance service return policies usually good shipping problem need fast order unusual take week.”, from these reviews, number of words are tokenized, each word is mapped with the list of predefined opinion words stored from a file separately for positive and negative words, if a word mapped is found positive, it is considered as positive word, an entry of it is made in a positive opinion word list and a corresponding value get incremented by 1, similarly it is mapped for a negative word. TABLE 1 shows the sample of word score of positive and negative words of neweggs.com reviews.

TABLE 1. Sample of word score of positive and negative words of neweggs.com reviews

R. No	Review	Positive words	Negative words	+ve word count	-ve word count	Total words
1	Good customer support chat	Good support	zero	2	0	4
2	problem involving bank stopping payment suspicion fraud	zero	problem suspicion fraud	0	3	7
3	Generally decent prices buyer beware lower priced products/specials items high percentage poor reviews/performance service return policies usually good shipping problem need fast order unusual take week. “	high good fast	beware lower poor problem unusual	3	5	27

Based on the polarity of opinion expression, positive and negative opinion words are extracted from the reviews and are stored in opinion word database separately for positive and negative opinion words. Let  $R=\{R_1,R_2,R_3\dots R_M\}$  be the reviews of the stores, given as input to opinion extraction. Let  $Pos_W=\{Pow_1,Pow_2, Pow_3\dots Pow_{A_1}\}$  be a list of positive opinion words and  $Neg_W=\{Negw_1,Negw_2,Negw_3,\dots Neg_B\}$  be a list of negative opinion words. Opinion words with different forms like beauty, beautify, beautiful, beautifully are considered as one word. A sample of extracted opinion words for both positive and negative words is

TABLE: 2a A sample of extracted positive opinion words

Pow <sub>1</sub>	Pow <sub>2</sub>	Pow <sub>3</sub>	Pow <sub>4</sub>	..	Pow <sub>A</sub>
good or goodly or goodness	support or supported or supporter	fast or faster or fastest	beauty or beautify or beautiful	..	success or successes or successful

TABLE: 2b A sample of extracted Negative opinion words

Negw <sub>1</sub>	Negw <sub>2</sub>	Negw <sub>3</sub>	Negw <sub>4</sub>	..	Negw <sub>B</sub>
issue or issues	suspicion or suspicious or suspiciously	Fraud or fraudulent or fraught	beware or beware or bewilder	..	problem or problems or problematic

**Sentiment polarity**

In the proposed work, we have used store reviews from Dhgate.com and Neweggs.com from review website resellarratings.com. The dataset consists of Seven thousand and seventy five (7075) reviews on two different stores. Half of these reviews (i.e.3537 reviews) are used for training and remaining half for testing the behavior (quality) of the reviews. The steps involved are: 1. Opinion words matrix construction and 2. Opinion ranking.

▪ **Opinion words matrix construction:**

Opinion words matrix is constructed by considering the extracted opinion words stored in opinion database.Let ‘P’ be the total number of opinion words for positive opinion and ‘N’ be the total number of opinion words for negative opinion. Further we construct a opinion word matrix ‘P1’ and ‘N1’ of order PXp and NXn for positive and negative opinion words for the review stores[16]. A sample of extracted opinion matrix for positive and negative words from one of the store is shown in TABLE 3a and Table 3b respectively.

TABLE : 3a Sample opinion words matrix of positive words

positive words	Good	easy	great	beautiful	:	success	Total
Review No	Pow <sub>1</sub>	Pow <sub>2</sub>	Pow <sub>3</sub>	Pow <sub>4</sub>	..	Pow <sub>A</sub>	
R <sub>1</sub>	1	0	0	1	..	1	4
R <sub>2</sub>	1	0	1	0	...	1	3
R <sub>3</sub>	1	1	1	1	...	0	6
:	:	:	:	:	:	:	:
R <sub>M</sub>	1	1	0	1	...	1	4
Total $\sum_{i=1}^M R$							

Negative words	issue	low	difficult	problem	:	deceptive	Total
Review No	Neg <sub>1</sub>	Neg <sub>2</sub>	Neg <sub>3</sub>	Neg <sub>4</sub>	..	Neg <sub>B</sub>	
R <sub>1</sub>	0	1	0	0	..	0	1
R <sub>2</sub>	1	0	1	0	...	0	2
R <sub>3</sub>							
:	1	0	1	1	...	1	4
R <sub>M</sub>	:	:	:	:	:	:	:
Total $\sum_{i=1}^M R$							

TABLE : 3b Sample opinion words matrix of negative words

▪ **Opinion Ranking**

Opinion words stored in opinion database are taken and the list of words is grouped based on occurrence of the positive /negative words from the two stores. Ordering of opinion words as positive and negative is measured based on the frequency of occurrence of each word (positive/negative) from the review stores. The frequency of occurrence is calculated by column sum for each opinion word taken from the two review stores for both positive and negative opinion words as shown in TABLE 3. Further opinion word with maximum frequency is ranked one, that with the second highest frequency is ranked two and so on for all the words for both the positive and negative opinion words. A sample of frequency distribution of the store Dhgate.com for positive opinion words and negative opinion words is shown in Figure 1a and 1b.

Fig.1a Rank based frequency distribution of positive opinion words

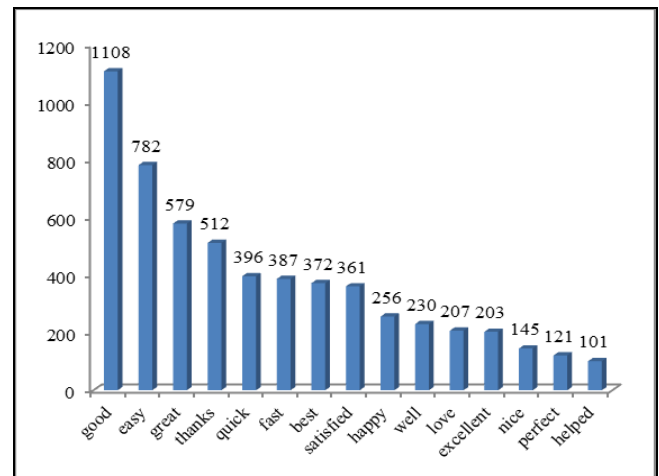
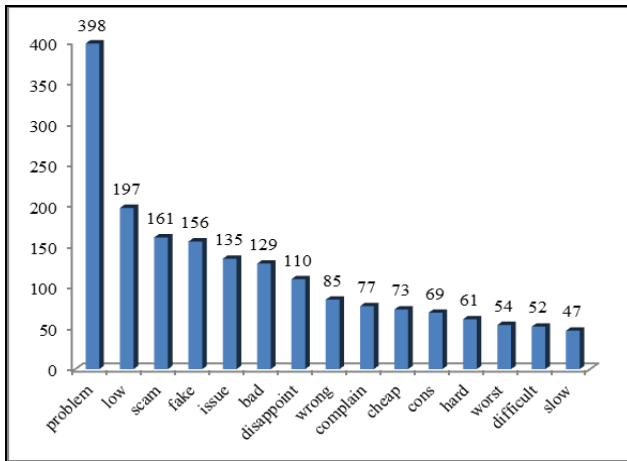


Fig.1b Rank based frequency distribution of Negative opinion words



**Review Spamicity Based on Rank and Contents of the review**

In this step of the proposed technique, we find review spamicity based on rank and content of the reviews. Reviews from review database, opinion analyzed database and opinion word database are inputs for finding the spamicity of the reviews based on rank (rating) and contents of the reviews. The algorithm for rating computed based on the content of the review i.e. (MR) is given in Algorithm 1 and difference between the rating posted by the reviewer i.e. (AR) and rating computed based on the content of the review (MR) is given in Algorithm 2. To count number of positive and negative score in a review a method known as counting method is used.

**Counting method**

In this method the lexicon was applied by counting positive and negative words found in a review. The positive and negative word length score can be obtained by dividing number of positive words ‘PosW’, negative words ‘NegW’ by total number of words in review ‘TW’. The equations for positive and negative word length score:

$$\text{Pos\_score} = \text{PosW}/\text{TW}$$

$$\text{Neg\_score} = \text{NegW}/\text{TW}$$

$$\text{TW} = \text{PosW} + \text{NegW}$$

Where,

PosW = number of positive words

NegW = number of negative words

Pos\_score = positive word length score

Neg\_score = negative word length score

If  $0.5 \leq \text{Pos\_score} \leq 1.0$ , then the review is considered as positive. If  $\text{PosW} = \text{NegW}$ , then the review is considered as neutral. If  $0.5 \leq \text{Neg\_score} \leq 1.0$ , then the review is considered as negative. The criteria for rating computed based on the

content of the review (MR) are given by the following IF-THEN rules:

IF  $0.5 \leq \text{Neg\_score} < 0.75$  THEN review rating is 1

IF  $0.75 \leq \text{Neg\_score} \leq 1.0$  THEN review rating is 2

IF  $\text{PosW} = \text{NegW}$  THEN review rating is 3

IF  $0.5 \leq \text{Pos\_score} < 0.75$  THEN review rating is 4

IF  $0.75 \leq \text{Pos\_score} \leq 1.0$  THEN review rating is 5

The proposed technique to measure rating computed based on the content of the review (MR) is given in Algorithm1.

ALGORITHM1. Find rating computed based on the content of the review (MR).

// Input: Reviews of stores

// Output: Rating computed based on the content of the review (MR)

```

FOR each review Ri DO
{
    Calculate total words in a review
    TW = PosW+NegW
    Calculate number of positive words in a review
    PosW = PosW/TW
    Calculate number of negative words in a review
    NegW=NegW/ TW

    IF ( PosW = NegW) THEN MR = 3.

    ELSE IF (PosW > NegW )
    {
        IF ( Pos_Score>0.75)THEN MR =5

        ELSE MR=4
    }
    ELSE
    {
        IF (Neg_Score > 0.75) THEN MR =2

        ELSE MR=1
    }
}
    
```

After calculating the rating computed based on the content of the review (MR), for the reviews from the two stores, the ratings given by the reviewers (AR) are compared with the rating computed based on the content of the review (MR) and we find the difference between both the ratings. Then the difference between the ratings are given as Rank\_diff = |AR-MR|. As the ratings given in the review will not exceed rating scale 5, in our work a threshold is fixed as two. Hence if the Rank\_diff is greater than or equal to two ( $\geq 2$ ), then those reviews are suspected to be spam reviews.

The proposed technique to find review spamicity is described in Algorithm2.

ALGORITHM 2 : Algorithm to find review spam

// Input : Reviews of stores

// Output : Review spam

```

Read all reviews from review database
R={ R1,R2,R3,.....RM}
FOR each review Ri
{
  Find rating computed based on the content of the review
  (MRi) // call MR function
  // Compare ratings given by the reviewers (ARi) with rating
  computed based on the content of the review (MRi)
  // Find Rank difference
  Rank_diff = |ARi-MRi|
  IF ( Rank_diff ) >=2 THEN review Ri is spam
  ELSE review Ri is not spam
}
    
```

Hence the content of the review is measured on the positive and negative sentiment on the two stores taken from review website resellarratings.com. If majority of the reviews only expresses positive sentiment or negative sentiment on the product/store, it tends to be spam, as the real reviews will express both sides of sentiments. Therefore we compute the ratio of positive and negative text at the word and sentence level in a review. The positive and negative sentiments are identified by Sentiment lexicons. Here we count the number of positive words and negative words in the review and predict the sentiment by comparing word count. The content of the reviews will represent more accurate sentiment of the reviewer, compared with rating score. Therefore it will indeed influence the potential customer. Three main observations about the rating and content of the reviews are listed below:

(1).The inconsistency between rating and sentiment polarity (content) exist in reviews. It is obvious that the rating and the sentiment polarity of two reviews are contradicted as there is no match with the rating posted by the reviewers with that of rating computed based on the content of the review. There are large number of reviews whose rating and the sentiment polarity is inconsistent. A sample of two reviews are shown in TABLE 4

Review	Rating (scale) posted by reviewer	Content of the Review	Rating (scale) computed based on the content of the review
A	4	The bulbs purchased were not the same dimensions as shown on the sellers web page.; To date e-mails with the seller have not resolved the problem.; Not sure how to proceed	1
B	2	Very user friendly website which is extremely easy to navigate. Checkout process was simple and excellent follow up emails after submitting a purchase.	5

TABLE: 4 Sample of reviews with inconsistent rating and content of the review.

which are collected from Dhgate.com store. (2).The sentiment strength expressed in the review varies considerably The sentiment strength of review example in the review “The customer service of Dhgate is very good” and the review “I like the customer service of Dhgate” are different. Although all the sentiment polarity is positive, the former review has specific description of the store service, and the latter review just has rough evaluation Therefore they have different sentiment strength[17]. (3) The sentiment strength differs when two reviews have different number of sentences. For instance, two reviews have the same rating scores. However, one review has lots of sentences, and has detail description about the shopping procedure, usage of the product and service quality as well. The other review has just one or two sentences with simple comment without trustful fact to support. It is obviously that the former will be convincing than the latter. According to the analysis mentioned above, the content of reviews is more important than rating score [18].

#### IV. EXPERIMENTAL RESULTS

Experiments are presented to demonstrate the efficiency of the proposed methods. We apply the proposed technique to see how effective it is in assessing the reviews as spam reviews. We conduct experiments from extracting reviews from review website resellerrating.com for two stores Dhgate.com and Neweggs.com from January 1<sup>st</sup> 2019 to March 15<sup>th</sup> 2020. It contains 80, 95,735 reviews for 1,37,645 stores as on 15<sup>th</sup> March 2020. We choose 8758 reviews from Dhgate.com and 4317 reviews from Neweggs.com. The stop words are filtered in the dataset. Two sets of lists from the literature (dictionary) have been given as input, both of which contain positive and negative terms. No list of neutral terms has been taken into consideration, since literature does not provide such lists [19]. To facilitate the opinion mining task, the Counting method is developed, so that it can produce the count of total words by distinguishing them into positive and negative words. The count of the total words is important because it helps the researcher to recognize how many words are positively total, how many are negatively total [20]. Experimental results are shown in TABLE 5. Spamicity is measured based on the content and ratings of the reviews. First we calculated rating computed based on the content of the review (MR) in Algorithm1. Next we compare the ratings given by the reviewers (AR) and rating computed based on the content of the review (MR) of the reviewers by finding the difference between them in Algorithm 2. A threshold is fixed based on the rating scale. As the rating scale is five for the store reviews in the proposed work, a threshold is fixed as the value greater than or equal to two (>=2). Hence, the results from the experimental table below demonstrate the percentage of reviews with different ratings for the two stores.

TABLE 5. Comparative table for percentage of reviews with different ratings for the stores, namely, Dhgate.com and Neweggs.com

Difference in Ratings  AR-MR	Percentage of reviews	
	Dhgate.com	Neweggs.com
>=1	19.52	30.48
>=2	20.65	33.95
>=3	09.88.	11.40.
>=4	09..55	06.91
>=5	03.44.	02.89

The spam detection rates are 19.52%, and 30.48% for the stores Dhgate.com and Neweggs.com respectively.

## V. CONCLUSION AND FUTURE WORK

In this paper, we propose a novel and effective technique, SentiWordNet, a valuable lexicon, used to sentiment analysis for reviews, and a method termed as counting method, to find positive and negative opinion words in a review .Spamicity is measured based on the content and ratings of the reviews. This is performed in three steps: (1) Extract reviews for the stores Dhgate.com and Neweggs.com from review website resellarratings.com. (2)Analyze reviews using Linguistic approach (3) Opinion orientation i.e. to find positive and negative opinion words using lexical approach and to have a count of positive and negative words using Counting method. Review Spamicity is detected, from Algorithm1 and Algorithm 2. Experimental results demonstrate that, proposed technique is effective to detect spamicity of reviews based on the content and ratings of the reviews. Detecting spam reviews considering posting dates of the reviewers gives the scope for future work.

## REFERENCES

[1] Hiremath, P.S Benchalli, S.S., Algur Siddu P., and Renuka Udupudi. "Mining Data Regions from Web Pages" COMAD-2005.

[2] Qingxi Peng and Ming Zhong ,” Detecting Spam Review through Sentiment Analysis “Journal of Software, vol. 9, no. 8, august 2014.

[3] Siddu P. Algur, Amit P.Patil, P.S Hiremath, S. Shivashankar “Conceptual level Similarity Measure based Review Spam Detection” 2010 IEEE

[4] B. Pang and L. Lee, “Opinion mining and sentiment analysis,” Foundations and Trends in Information Retrieval 2(1-2),2008

[5] Siddu P. Algur , Jyoti G Biradar “Review Spam Detection from Multiple Websites Using Conceptual Level Similarity Measure”. In: IEEE international conference on Soft Computing and Network Security,ICSNS-2015.ISBN978-1-4799-1752-5.

[6] Nitin Jindal and Bing Liu. Opinion spam and analysis. In Proceedings of the 2008 International Conference, WSDM, 2008. ACM. ISBN 978-1-59593-927-2.

[7] Myle Ott, Yejin Choi, Claire Cardie, and Je\_rey T. Hancock. Finding deceptive opinion spam by any stretch of the magination. In Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies -, 2011.ISBN 978-1-932432-87-9.

[8] Siddu P. Algur, Jyoti G.Biradar, Prashant Bhat.,“ GARCH(1,1) Outlier detection technique for review spam detection” International Journal of Emerging Trends and Technology in Computer Science (IJETTCS).,Vol 5,Issue 6, ISSN:2278-6856, pp.6-15, Nov-Dec 2016.

[9] Raymond Y. K. Lau, S. Y. Liao, Ron Chi-Wai Kwok, Kaiquan Xu, Yunqing Xia, Yuefeng Li,” Text mining and probabilistic modeling for online review spam detection” ACM Transactions on Management Information Systems (TMIS) , Volume 2 Issue 4,Article 25,2011.

[10] Siddu. P. Algur, A.P. Patil, P.S Hiremath, S. Shivashankar, Spam Detection of Customer Reviews from Web Pages,” IT and Business Intelligence .

[11] Guan Wang, Sihong Xie, Bing Liu, Philip S. Yu “Review graph based online store review spammer detection”, Proceedings of the 2011 IEEE 11th International Conference on Data Mining, pp.1242-1247,2011.

[12] Sihong Xie, Guan Wang, Shuyang Lin, Philip S. Yu “Review spam detection via time series pattern discovery”, ACM Proceedings of the 21st international conference companion on World Wide Web,pp.635-636,2012

[13] Sihong Xie, Guan Wang, Shuyang Lin, and Philip S. Yu. Review spam detection via time series pattern discovery. In Proceedings of the 21st International Conference Companion on World Wide Web, WWW'12 Companion, 2012. ACM. ISBN 978-1-4503-1230-1.

[14] Arjun Mukherjee, Bing Liu, Junhui Wang, Natalie Glance, Nitin Jindal ,” Detecting group review spam” ,ACM Proceedings of the 20th international conference companion on World wide web, pp.93-94,2011.

[15] Chan Myae Aye, and Kyaw May Oo,” Review Spammer Detection by using Behaviors Based Scoring Methods”, International Conference on Advances in Engineering and Technology (ICAET'2014) Singapore.

[16] P.S.Hiremath, Siddu P.Algur, Shivashankar S. “Web based Quality Assessment of Customer Reviews Using Quartile Measure “International Journal of Recent Trends in Engineering, Vol. (1) – No. (1) 2009

[17] Jindal, Nitin, and Bing Liu. Mining comparative sentences and relations. AAAI. Vol. 22. 2006..

[18] Qingxi Peng and Ming Zhong, “Detecting Spam Review through Sentiment Analysis” Journal of software, vol. 9, no. 8, august 2014.

[19] Antonis Koukourikos, Giannis Stoitsis, Pythagoras Karampiperis “Sentiment analysis : A tool for Rating

Attribution to Content in Recommender Systems  
“RecSysTEL

- [20] Alaa Hamouda Mohamed Rohaim, “Reviews Classification Using SentiWordNet Lexicon” The Online Journal on Computer Science and Information Technology (OJCSIT).
- [21] Siddu P. Algur, Jyoti G. Biradar and Prashant Bhat “Multidimensional Time Series Based Review Spam Detection” International Journal of Innovative Research in Computer and Communication Engineering(IJIRCCE) “Vol.4, Issue 6, pp.11761-11774., June 2016.
- [22] Nitin Jindal and Bing Liu. “Opinion spam and analysis”. In Proceedings of the International Conference on Web Search and Data Mining, pp. 219–230, ACM, 2008.