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A New Approach for Identifying Manipulated Online Reviews using Decision Tree

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***Abstract*— Now-a-days an internet has become an essential thing, as it provides more facilities to its users. There are many social networking sites which offer users to share their views. People share their thoughts about politics, social issues as well as about different products. It is a common practice today that before purchasing anything user checks the reviews of that product online. There are multiple sites which deal with these reviews. They provide ratings for the products as well as show comparison between different products. Some enterprises attempt to create fake reviews to affect customer behaviours and increase their sales. But, how to identify those fake reviews is a difficult task for customers. In today's world of competition it is necessary for any enterprise to maintain its reputation in a market. So it is necessary for both, i.e. enterprise and customer to identify manipulated reviews. This paper studies different approaches for identifying manipulated reviews and proposes a new approach to identify those manipulated reviews using Decision Tree (DT).**

Keywords—**Review Manipulation, Decision Tree, Feature Selection, Ensemble Decision tree.**

I. INTRODUCTION

A. Overview

In today's world of internet everything has become fast. Because of too many social networking sites people are interacting with each other across the world. They can share their thoughts on internet. Internet has also provided the facility of online shopping, so related to this on company's website or some review sites like Amazon, Yelp lots of reviews about product are available. Before purchasing anything, it is a normal human behavior to do a survey on that. These websites are helping people to check quality of product. Based on reviews customer can compare different brands of product and can final a product. These online reviews can change the mind set of customer. If these reviews are true then these can help users to select proper product satisfying his requirement. On the other hand, if reviews are manipulated or not true then it can mislead user.

B. Manipulated Reviews

We define reviews manipulation as writers, publishers, or company people or any third-party writing untrue comments or reviews on behalf of customer when needed, to increase the sales of their products. A customer review consists of two parts, one with star rating and other with textual comments. If unauthentic person posts review, he may either give high rating to the product or can manipulate textual comment. So by analyzing writing styles of user we can detect manipulated reviews.

C. Motivation

Identifying manipulated online reviews is one of the hot topics in current research areas. Manipulated reviews can be harmful to the enterprise as well as to the customer. If some competitor enterprise writers negative comment about the product or company, or giving very low rating to their product then it can harm the company's reputation and can suddenly change the business situations, because many customers follow these reviews before making any decision about product purchase. In case of customer if suppose any enterprise is posting positive comments for its own product then this can affect the customer's decision and can misguide the user. So in today's world of e-commerce, there is a need to find a solution to this problem, which can give more accuracy in pointing out manipulated reviews.

II. LITERATURE REVIEW

This paper gives study of identifying manipulated reviews using different methods. As this is very newly introduced problem because of intensive use of e-commerce websites, there are very few works related to this.

In [1], the first attempt for identifying manipulated reviews i.e. detecting review spam was taken. In this paper, they have highlighted that there are two types of review spam, one is manipulated review which will mislead the customer and another is non-review i.e. it is not giving any actual opinion about the product, it can be advertisement of product. The objective of this paper was to perform spam detection based on duplicate findings and classification. They have classified the reviews in two categories as spam and non-spam review. This paper performs spam detection based on two methods.

1. *Duplicate Detection*: There are many numbers of duplicate reviews and many of them are spam. Fake person uses different userids to post duplicate reviews or can use same meaning review. This used to delete those duplicate reviews.
2. *Spam classification:*After finding duplicate reviews the focus is given to 2-class classification (spam and non-spam)

This paper uses logical regression to produce probability estimation that each review is spam.

The next [2] paper introduces use of temporal pattern discovery in identifying manipulated reviews. To address this problem, this paper states that the normal reviewers' arrival pattern is stable and uncorrelated to their rating

pattern temporally. In contrast, spam attacks are usually unstable and either positively or negatively correlated to the rating. Thus, it is proposed that to detect such attacks via unusually correlated temporal patterns. This paper identifies and constructs multidimensional time series based on aggregate statistics, in order to depict and mine such correlations. In this way, the singleton review spam detection problem is mapped to an abnormally correlated pattern detection problem. Proposed system has a hierarchical algorithm to robustly detect the time windows where such attacks are likely to have happened. The algorithm also pinpoints such windows in different time resolutions to facilitate faster human inspection. Experimental results show that the proposed method is effective in detecting singleton review attacks.

Customers increasingly rely on online reviews before purchasing any product. In [3], opinion spam is fake review written to sound authentic and deliberately mislead readers. This paper is identifying manipulated offerings on review portal. Author introduces a semi supervised manifold ranking algorithm to identify this. The problem of manipulated offering is framed as ranking problem. This is to rank the offerings by the proportion of their reviews that are believed to be deceptive. The proposed method is to form three layer graph model based on manifold ranking. Manifold ranking approach is semi supervised in that it requires only small amount of labeled data at review level. Fig 1 shows the graph model for hotel ranking using the manifold Ranking method.

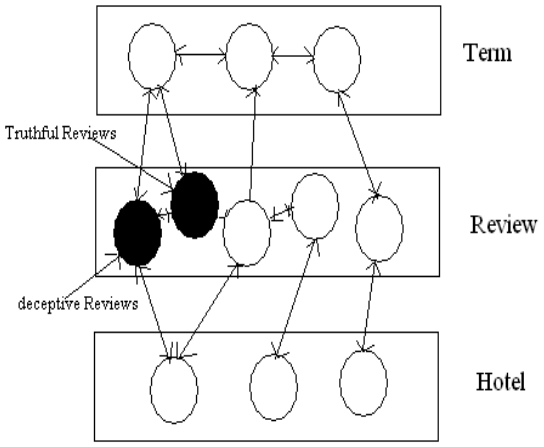

Fig. 1 Graph model for manifold Ranking Method

Many researchers have developed various sentiment analysis tasks. This work provides users to retrieve in general opinion about the product. But many of them are assuming that whatever the reviews or opinion available on internet are truthful. However in practice these reviews can be faked. [4] Exploits machine learning methods to identify such fake reviews. One way of identifying fake review is that reviewer is anonymous or fake. This paper discussed a framework of product review mining system. This paper provides various features of reviews and reviewer.

Review related features:

1. Content Feature*:*

Unigram and bigram:
This uses feature selection matrix x^2 to select the text classification feature.
Square of normalized length:
A length of the review, normalized by the maximum length, is extracted as a real number feature.
First Person vs. Second Person:
This paper says that fake reviewer uses second person in reviews e.g. "you should buy this product", etc. whereas real user shares his experience about the product. This feature is again selected as a real number.
High similarity score:
The fake reviewer can use same review for multiple brands or product, so identifying high similarity score is also important.

2. Sentiment features:

Subjective vs. Objective
If review contains many objectives, then it is considered that this review is not real. It is for advertisement purpose.
Positive vs. Negative
Analysis shows that real review holds combination of positive and negative sentiments, hence if a comment having only positive or only negative sentiment then it can be a manipulated one.

3. Product features:

Product Centric features
The study also shows that manipulated reviews contain more number of product centric features.
Product Description Features
Product description also considered. Fake review might not have name of the product.

Reviewer Related Features:

1. Profile Features
2. Behavior Features

Above work uses supervised learning methods and analyze the effect of various features on identifying manipulated reviews and two view semi-supervised method to exploit the large amount of unlabeled data.

In [5], proposed work finds out the three types of manipulation on reviews and joins the result to give final opinion to both customer and enterprise. The work classifies reviews on following types:

1. *Untruthful Review*

This review contains either more positive or more negative review

2. *Review on Brand*

These types of reviews are only on Brand they do not give any comment on product. These reviews are basically for advertisement purpose.

3. *Non Review*

These reviews include advertisement, other irrelevant things as questions, answer etc.

This paper uses feature selection for identifying reviews on brand and n- gram model to identify untruthful reviews.

In [6], the study employs Decision tree to improve the classification performance of manipulated reviews. This paper introduces eight potential factors for identifying manipulated reviews using correlation analysis and extracted knowledge rules.

The eight potential factors are:

1. *Text Difficulty:*

Following formula gives text difficulty of the sentence.

$$206.835 - (1.015\ x\ ASL) - (84.6\ x\ ASW)$$

ASL= Average Sentence Length
AWS= Average number of syllables per word

2. *TTR(Type-Token Ratio):*

Type-Token Ratio (TTR) is another index to measure the readability of one text comment.

$$TTR = Types/Tokens$$

"Tokens" is the number of individual words in the text and "Types" is the number word types in text comment.

3. *Tokens:*
   According to research, length of sentence also affects the readability of the sentence.

4. *Positive sentiment:*
   Positive comment has great impact on user. If user really wants to purchase the product, he simply ignores the negative comment.

5. *Negative Sentiment*
   Researchers have shown that negative reviews increase the sales as compare to the products which haven't discussed [6].
6. *Sentiment:*
   Sentiment affects the behavior of customer, no matter it is positive or negative.

7. *Product Characteristics:*
   Authors of manipulated reviews try to focus on the product specifications. Hence there will be more number of product characteristic and specification will be mentioned in the comment.

8. *Expertise:*
   If a comment or review contains too many terms of domain knowledge then that comment is treated as expertise.

Based on these eight potential factors proposed work classifies reviews using Decision Tree, along with that correlation analysis and knowledge rules discovered by decision tree are used to select key review manipulation attribute.

[7] Paper discussed about the different term to consider for identifying manipulated reviews. This paper tells that as time increases the amount of manipulation decreases.

Nan Hu, Indranil Bose and Ling Liu have provided the statistical method for identifying manipulated reviews [8]. Paper [9] introduces a framework for identifying manipulated reviews. They also considered different text related attributes, sentiments for identifying manipulation. The result is calculated by considering case study of reviews of books.

III. PROPOSED METHOD

In recent years, opinion mining is the hot research area. This work considers that whatever comments, opinions, which are available online, are trustworthy. But in practice these reviews can be faked. Above few researches enlighten this way of identifying manipulated or fake reviews. First paper [1] is using two methods for classifying reviews as Duplicate detection and spam classification. Other two papers [5] [6] uses some of the text characteristics of comment to classify these reviews. So basically for classifying reviews there is lots of text analysis done, addition to that behavior of reviewer is also analyzed.

As in [6], classification takes place using decision tree algorithm. We can employ bagging and boosting method to increase accuracy of the classification. Along with eight potential factors used we can add some reviewer related attributes such as profile attributes and behaviour attributes [5].

Considering above literature survey we propose a method for classifying online product reviews using decision tree. We define potential attributes for classifying reviews. These attributes define the review. First we analyse the content of review, which is related to the readability of review. Next category defines sentiment related attributes. We also define product related and reviewer related attributes.

These attributes are as follows:

Content Related Features:

1) Text Difficulty
2) TTR (Token Type Ratio)
3) Length
4) High similarity Square

Sentiment Related Features:

1) Positive Sentiment
2) Negative Sentiment
3) Sentiment

Product Related Features:

1) Product Specification
2) Product Description

Reviewer Related Features:

1) Profile Specification
2) Behavior Specification

Fig. 2 shows the implemental procedure of the proposed work. We collect product reviews from different review websites. The next step is to preprocess data. Online reviews contain many duplicate reviews, reviews which do not provide any helpful information about product, reviews which talks about only brand of product and so on. We need to remove these untruthful reviews. After preprocessing we define review manipulation attributes, which we have discussed above. We create a Term Document Matrix (TDM) and finally will implement decision tree.

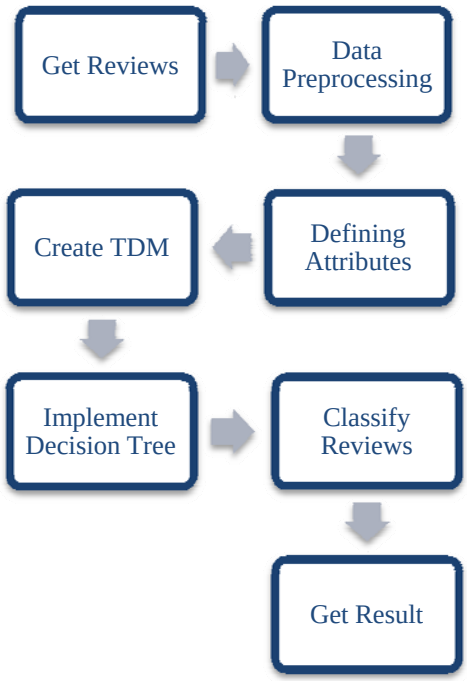

Fig. 2 Implementation Procedure

The procedure as follows:

Step 1: Get set of reviews for particular product from different website

Step 2: Preprocess Data

We use unigram to represent collected reviews. This step removes all stop words, some untruthful reviews.

Step 3: Define Attributes

From available literature we define review manipulation attributes

Step 4: Create TDM

Every single review is converted into Term Document Matrix (TDM) based on the features discussed above.

Step 5: Implement Decision Tree.

This step construct the decision tree and selects the best features to classify which will give maximum accuracy of classification.

Step 6: Get Results and evaluate performance.

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IV. CONCLUSION

In this paper, we studied different approaches for finding manipulated reviews. In today's world of e-commerce, there is a strong need of identifying fake reviews. Many of the papers are using machine learning algorithm for finding manipulated reviews. More focus is given on the behavior of the reviewer and different text properties of comments. The proposed method employs decision tree algorithm to classify manipulated reviews. Decision tree is used to select the features which will give maximum accuracy. To increase the accuracy of the classification bagging and boosting methods can be introduced.

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