ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 3, Issue 10 , October 2016

A Study of Effective Sentiment Analysis Process for Opinion Mining

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ABSTRACT: Internet has become a platform for online learning, exchanging ideas and sharing opinions. Due to the sheer volume of opinion rich web resources such as discussion forum, review sites, blogs and news corporate available in digital form, much of the current research is focusing on the area of sentiment analysis. Social networking sites are rapidly gaining popularity as they allow people to share and express their views about topics, have discussion with different communities, or post messages across the world. There has been lot of work in the field of sentiment analysis of social networking data. This study focuses mainly on sentiment analysis of data which is helpful to analyze the information in the wordnet where opinions are highly unstructured, heterogeneous and are either positive or negative, or neutral in some cases. In this paper, we provide a study for opinion mining like Feature extraction is a crucial step for opinion mining which been used to collect the useful information from user reviews and one that takes as input these features, assigns ranks to them and decides the final classification of the review as positive, neutral, or negative. The algorithm we propose to identify the features is called the Improved High Adjective Count (IHAC). This will be done by Artificial Bee Colony (ABC) optimization algorithm. The main idea behind the algorithm is the nouns for which reviewers express a lot of opinions are most likely to be the important and distinguishing than those for which users don't express such opinions. After processing all reviews the algorithm will score for each noun. The ranking will be used to filter to find which scores above a threshold, and the second proposed algorithm is Max opinion score algorithm which ranks the extracted features using opinion scores assigned from previous method. Till now, there are few different problems predominating in this research community, namely, sentiment classification, feature based classification and handling negations. This paper presents a study covering the techniques and methods in sentiment analysis and challenges appear in the field.

KEYWORDS: Sentiment analysis, Opinion Mining, IHAC, and ABC.

I. INTRODUCTION

The advent of the World Wide Web has overwhelmed home computer users with an enormous flood of information. To almost any topic one can think of, one can find pieces of information that are made available by other internet citizens, ranging from individual users that post an inventory of their record collection, to major companies that do business over the Web[1]. Finding the relevant and required information is tedious task. Information is so vast that it cannot be directly used for business purposes. Web mining is an approach in which data mining techniques are applied on the web data. Web mining is the use of data mining techniques for automatic discovery and knowledge extraction from documents and Web services [3]. This new area of research was defined as an interdisciplinary field or multidisciplinary that uses techniques borrowed from: data mining, text mining, databases, statistics, machine learning, multimedia, etc. Web mining has three operations of interests - clustering (finding natural groupings of users, pages etc.), associations (which URLs tend to be requested together), and sequential analysis (the order in which URLs tend to be accessed).

As in most real-world problems, the clusters and associations in Web mining do not have crisp boundaries and often overlap considerably [2]. In addition, bad exemplars (outliers) and incomplete data can easily occur in the data set, due to a wide variety of reasons inherent to web browsing and logging. Thus, Web Mining and Personalization requires modeling of an unknown number of overlapping sets in the presence of significant noise and outliers, i.e. bad exemplars). Moreover, the data sets in Web Mining are extremely large. Web mining approaches can be used in

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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extracting the relevant information from the huge internet database [5]. The data on the web is heterogeneous varying from structured to almost unstructured data like images, audios and videos [4]. There is enormous amount of information available on internet web resulting in multiple pages containing almost same or similar information differing in words and/or formats. A significant amount of information on the web were linked one by another.

The overall process of web mining includes extraction of information from the World Wide Web through the conventional practices of the data mining and putting the same into the website features [15]. The Web is a critical channel of communication and promoting a company image. E-commerce sites are important sales channels. It is important to use data mining methods to analyze data from the activities performed by visitors on websites. Web mining methods are divided into three categories: Web content mining, Web structure mining and Web usage mining. Web content mining search automatically and retrieves information from a huge collection of websites and online database using search engine [3]. This mining process attempts to discover all the hyperlinks in a document so as to generate the structural report on a web page. There are two groups of web content mining strategies. First strategy is to directly mine the content of documents and the second one are those that improve on the content search of other tool e search engines. Web structure mining is discovering the model underlying link structures on the web[8]. This involves the usage of graph theory for analyzing the connections and node structure of the website.

According to the type and nature of the data of the web structure, it is divided into two kinds such as Extraction of patterns from the hyperlink on the net: The hyperlink is structural form of web address connecting a web page to some other locations and Mining of the structure of the document: The tree like structure gets used for analyzing and describing the XHTML or the HTML tags in the web page. Web usage mining mines the log files and data associated with any website to discover and analyze the user patterns [14]. This mining process, are applied so as to discover the trends and the patterns in the browsing nature of the visitors of the website. There is extraction of the navigation patterns as the browsing patterns could be traced and the structure of the website can be designed accordingly. When it is talked about the browsing nature of the user it deals with frequent access of the web site or the duration of using the web site. This information can be extracted from the log file. Only these log files record the session information about the web pages.

There are situations in which the user needs those web pages on the Internet to be available offline for convenience. The reason being offline availability of data, limited download slots, storing data for future use, etc [15]. This essentially leads to downloading raw data from the web pages on the Internet that is a major set of the inputs to a variety of software that are available today for the purpose of data mining. In the recent years there has been lot of improvements on technology with products differing in the slightest of terms. Every product needs to be tested thoroughly, and internet plays a vital role in gathering of information for the effective analysis of the products

II. REVIEW OF RECENT RESEARCHES

Vu, Tien-Thanh, *et al.* [7] had proposed a Feature-based opinion mining and summarizing (FOMS) of reviews is an interesting issue in opinion mining field. In this paper, we propose an opinion mining model on Vietnamese reviews on mobile phone products. Explicit/Implicit feature-words and opinion-words were extracted by using Vietnamese syntax rules as same as synonym feature words were grouped into a feature, which belongs to the feature dictionary. Customers' opinion orientations and summarization on features were determined by using VietSentiWordNet and suitable formulas.

Tak-Lam Wonga and Wai LamOur [8], were described their approach were based on an undirected graphical model which can model the interdependence between the text fragments within the same Web page, as well as text fragmenting different Web pages. Web pages across different sites are considered simultaneously and hence information from different sources can be effectively leveraged. An approximate learning algorithm is developed to conduct inference over the graphical model to tackle the information extraction and feature mining tasks. They demonstrated the efficacy of our framework by applying it to two applications, namely, important product feature mining from vendor sites, and hot item feature mining from auction sites. Extensive experiments on real-world data have been conducted to demonstrate the effectiveness of their framework.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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Kang Liu *et al.* [9] had proposed a novel approach to extract opinion targets based on word based translation model (WTM). Firstly they applied WTM in a monolingual scenario to mine the associations between opinion targets and opinion words. Then, a graph-based algorithm is exploited to extract opinion targets, where candidate opinion relevance estimated from the mined associations, is incorporated with candidate importance to generate a global measure. By using WTM, this method can capture opinion relations more precisely, especially for long-span relations. When compared with previous syntax-based methods, this method can effectively avoid noises from parsing errors when dealing with informal texts in large Web corpora. By using graph-based algorithm, opinion targets are extracted in a global process, which can effectively alleviate the problem of error propagation in traditional bootstrap-based methods, such as Double Propagation. The experimental results on three real world datasets in different sizes and languages show that this approach is more effective and robust than state-of-art methods.

Lei Zhang and Bing Liu [10] had been focused on adjectives and to extent verbs. Limited work has been done on nouns and noun phrases. In their work, they used the feature-based opinion mining model, and found that in some domains nouns and noun phrases that indicate product features may also imply opinions. In many such cases, these nouns are not subjective but objective. Their involved sentences are also objective sentences and imply positive or negative opinions. Identifying such nouns and noun phrases and their polarities is very challenging but critical for effective opinion mining in these domains. Their paper had proposed a method to deal with the problem. Experimental results based on real-life datasets show promising results.

Ahmad Kamal and Muhammad Abulaish [11] had proposed a sentiment analysis system which combines rule-based and machine learning approaches to identify feature-opinion pairs and their polarity. The efficiency of the proposed system is established through experimentation over customer reviews on different electronic products.

Zhongwu, *et al.* [12] proposed in their paper; firstly extend a popular topic modeling method, called LDA, with the ability to process large scale constraints. Then, two novel methods were proposed to extract two types of constraints automatically. Finally, the resulting constrained-LDA and the extracted constraints are applied to group product features. Experiment results shown that the constrained-LDA outperforms the original LDA and the latest mLSA by a large margin.

Agarwal et al. [20] developed a 3-way model for classifying sentiment into positive, negative and neutral classes. They experimented with models such as: unigram model, a feature based model and a tree kernel based model. For tree kernel based model they represented tweets as a tree. The feature based model uses 100 features and the unigram model uses over 10,000 features. They arrived on a conclusion that features which combine prior polarity of words with their parts-of-speech (pos) tags are most important and play a major role in the classification task. The tree kernel based model outperformed the other two models.

Turney et al [21] used bag-of-words method for sentiment analysis in which the relationships between words was not at all considered and a document is represented as just a collection of words. To determine the sentiment for the whole document, sentiments of every word was determined and those values are united with some aggregation functions.

Kamps et al. [22] used the lexical database WordNet to determine the emotional content of a word along different dimensions. They developed a distance metric on WordNet and determined semantic polarity of adjectives.

Xia et al. [23] used an ensemble framework for Sentiment Classification which is obtained by combining various feature sets and classification techniques. In their work, they used two types of feature sets (Part-of-speech information and Word-relations) and three base classifiers (Naive Bayes, Maximum Entropy and Support Vector Machines). They applied ensemble approaches like fixed combination, weighted combination and Meta-classifier combination for sentiment classification and obtained better accuracy.

III. PROBLEM DEFINITION

In recent years, the spectacular development of web technologies, lead to an enormous quantity of user generated information in online systems. This large amount of information on web platforms make them viable for use

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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as data sources, in applications based on opinion mining and sentiment analysis [16]. The development of internet and web 2.0 technologies, enabled by cost reduction of technological infrastructure, has been an exponential increase in the amount of information in online systems. These very large volumes of information are very difficult to process by individuals, leading to information overload and affecting decision-making processes in organizations. Therefore, providing new techniques for creation of knowledge is important in organizational strategy [17].

Opinions Play important role in the process of knowledge discovery or information retrieval and can be considered as a sub discipline of Data Mining. A major interest has been received towards the automatic extraction of human opinions from web documents. The sole purpose of Sentiment Analysis is to facilitate online consumers in decision making process of purchasing new products. Opinion Mining deals with searching of sentiments that are expressed by Individuals through on-line reviews, surveys, feedback, personal blogs etc. With the vast increase in the utilization of Internet in today's era a similar increase has been seen in the use of blog's, reviews etc. The person who actually uses these reviews or blog's is mostly a consumer or a manufacturer. As most of the customers of the world are buying & selling product on-line so it becomes company's responsibility to make their product updated. In the current scenario companies are taking product reviews from the customers and on the basis of product reviews they are able to know in which they are lacking or strong this can be accomplished with the help of sentiment analysis [18].

The explosive growth of the user-generated content on the Web has offered a rich data source for mining opinions. However, the large number of diverse review sources challenges the individual users and organizations on how to use the opinion information effectively. Therefore, automated opinion mining and summarization techniques have become increasingly important [19]. In this feature extraction we used opinion mining under consideration for extracting the reviews of the product from different web pages. Providing reviews corresponding to the ratings does not only help users gain more insight in to item's quality but it also helps to compare different items. This feature based extraction using opinion mining addresses this need by performing two main tasks. Feature identification which means extracting and identifying feature from the users reviews. Rating prediction is estimating the numerical rating of the feature of the product.

IV. DATA SOURCE

People and companies across disciplines exploit the rich and unique source of data for varied purposes. The major decisive factor for the improvement of the quality services rendered and enrichment of deliverables are the user consumer's opinions. Review sites, blogs and micro blogs provide a good understanding of the reception level of products and services.

A. Review Sites

Opinions are the major and actual data or more precise a decision for any user in making a purchase. The user generated reviews for products and services are mainly available on internet. The sentiment classification uses reviewer's data are gathered and composed from the websites like www.gsmarena.com (mobile reviews), www.amazon.com (product reviews), www.CNETdownload.com (product reviews), which hosts millions of product reviews by consumers. [25]

B. Blogs

The name associated to universe of all the blog sites is called blogosphere. People write about the topics they want to share with others on a blog. Blogging is a happening thing because of its ease and simplicity of creating blog posts, its free form and unedited nature. We find a large number of posts on virtually every topic of interest on blogosphere. Sources of opinion in many of the studies related to sentiment analysis, blogs are used. [26]

C. Micro-blogging

A very accepted communication tool among Internet users is micro-blogging. We use this as one of the data source formed as a dataset of collected messages from Twitter. Twitter contains a very large number of very short messages created by the users, consumers of this micro blogging platform. Millions of messages appear daily in well-

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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liked web-sites for micro-blogging such as Twitter, Tumblr, Facebook. Twitter messages sometimes express opinions which are used as data source for classifying sentiment. [27]

V. PROPOSED METHODOLOGY

The primary intension of this research is to develop a technique for extracting the opinions from the online user reviews. The proposed methodology comprises of 3 major phases such as 1) Data Preprocessing 2) Opinion extraction 3) Opinion mining. Initially the data extracted from the web document which is unstructured. Initial phase is used for formatting the data before sentiment analysis and mining. In our proposed work for feature extraction of the product, we will use opinion mining which was widely used to identify the compare the strength and the weakness of the products based upon the feedback given by the users on user reviews. Feature extraction is a crucial step for opinion mining which been used to collect the useful information from user reviews and one that takes as input these features, assigns ranks to them and decides the final classification of the review as positive, neutral, or negative. The algorithm we propose to identify the features is called the Improved High Adjective Count (IHAC). This will be done by Artificial Bee Colony (ABC) optimization algorithm. The main idea behind the algorithm is the nouns for which reviewers express a lot of opinions are most likely to be the important and distinguishing than those for which users don't express such opinions. After processing all reviews the algorithm will score for each noun. The ranking will be used to filter to find which scores above a threshold, and the second proposed algorithm is Max opinion score algorithm which ranks the extracted features using opinion scores assigned from previous method.

This algorithm comprises three inputs, such as 1) the list of adjectives which are used to express opinions. 2) a score which indicates how positive or negative the opinion is 3) the list of potential features. This can be identified using algorithms like the proposed IHAC, or TF and TF-IDF. Finally an evaluation is used for the proposed algorithms for their feature extraction from different review sites. The proposed framework not only classifies a review as positive or negative, but also extracts the most representative features of each reviewed item, and as-signs opinion scores on them. The final phase will be done by supervised learning algorithm naïve bayes classifier or decision tree classifier with the help of features extracted. In the final step ranking and classification will be done.

VI. APPLICATIONS OF SENTIMENT ANALYSIS

Sentiment Analysis has many applications in various Fields.

A. Applications to Review Websites

Today Internet has a wide variety of reviews and feedbacks on almost everything. This includes product reviews, feedbacks on political issues, comments about services, etc. Thus there is a need for a sentiment analysis system that can extract sentiments about a particular product or services. It will help in providing feedback or rating for the given product, item, etc. This would serve the needs of both the users and the vendors.

B. Applications as a Sub-component Technology

A sentiment predictor system can be helpful in recommender systems as well. The recommender system will not recommend items that receive a lot of negative feedback or less rating. In online communication, we come across abusive language and other negative elements. These can be detected simply by identifying a highly negative sentiment and correspondingly taking action against it.

C. Applications in Business Intelligence

It has been observed that people nowadays tend to look upon reviews of products online before buying them. And for many businesses the online opinion can make or break their product. Thus, Sentiment Analysis plays an important role in businesses. Businesses also wish to extract sentiment from the online reviews in order to improve their products and in turn their reputation.

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D. Applications across different Domains

Studies in sociology and other fields have been benefitted by Sentiment Analysis that shows trends in human emotions especially on social media.

E. Applications in Smart Homes

Smart homes are supposed to be the technology of the future. In future entire homes would be networked and people would be able to control any part of the home using a tablet device. Recently there has been lot of research going on Internet of Things (IoT). Sentiment Analysis would also find its way in IoT. Like for example, based on the current sentiment or emotion of the user, the home could alter its ambiance to create a soothing and peaceful environment.

Sentiment Analysis can also be used in trend prediction. By tracking public views, important data regarding sales trends and customer satisfaction can be extracted.

VII. CHALLENGES IN OPINION MINING

1. Product reviews, comments and feedback could be in different languages; therefore to tackle each language according to its orientation is a challenging task.

2. As noun words are considered as feature words but Verbs and adjectives can also be used as feature words which are difficult to identify.

3. If a customer-One comments on mobile phone, "the voice quality is excellent" and customer-Two comments, "Sound quality of phone is very good". Both are talking about same feature but with different wording. To group the synonym words is also a challenging task.

4. Orientation of opinion words could be different according to situation. For example "Camera size of mobile phone is small". Here adjective small used in positive sense but if customer parallel said that "the battery time is also small". Here small represent negative orientation to battery of phone. To identify the polarity of same adjective words in different situation is also a challenging task.

5. As the customer comment in free format, she can use abbreviation, short words, and roman language in reviews. For example u for you, *cam for camera, pic for picture, f9 for fine, b4, before, gud for good etc.* To deal with such type of language need a lot of work to mine opinion.

6. Different people have different writing styles, same sentence may contain positive as well as negative opinion, so it is difficult to parse sentence as positive or negative in case of sentence level opinion mining.

7. In Bing Liu approach opinion always classified only in two categories positive and negative but Neutral opinion also expressed sometimes. Liu considers only adjective as opinion words but opinion can also expressed as adverb, adjectives and verb. For example "like" is a verb but also an opinion word. His approach finds the implicit features because it extracts the sentences contain at least one feature word. So the features commented by customer indirectly are ignored [24].

8. Lexicon based methods use for opinion mining has not an effective method to deal with context dependent words. For example the word "small" can express the either positive or negative opinion on the product features. For a mobile phone if customer comments that "size of mobile phone is small" this sentence does not show either size is positively opinioned or negatively.

9. Finding of spam and fake reviews, mainly through the identification of duplicates

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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10. The comparison of qualitative with summary reviews and the detection of outliers, and the reputation of the reviewer.

VIII. CONCLUSION

Sentiment analysis and detection has a wide variety of applications in information systems, including classifying reviews, summarizing review and other real time applications. There are likely to be many other applications that are not discussed. It is found that sentiment classifiers are severely dependent on domains or topics. From the above work it is evident that neither classification model consistently out performs the other, different types of features have distinct distributions. It is also found that different types of features and classification algorithms are combined in an efficient way in order to overcome their individual drawbacks and benefit from each other's merits, and finally enhance the sentiment classification performance.

In future, more work is needed on further improving the performance measures. Sentiment analysis can be applied for new applications. Although the techniques and algorithms used for sentiment analysis are advancing fast, however, a lot of problems in this field of study remain unsolved. The main challenging aspects exist in use of other languages, dealing with negation expressions; produce a summary of opinions based on product features/attributes, complexity of sentence/ document, handling of implicit product features, etc. More future research could be dedicated to these challenges.

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