



Predicting the sentiment analysis for the customer reviews to analyze the text analytics.

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Abstract

The social web has generated huge amounts of data for the users across the globe with just the click of a button. Even in the age of digitalization other's opinions are considered while making a decision. This reliability is found in the form of opinions and experiences regarding a particular product or service. Sentiment analysis discusses these opinions. The information gathered through the World Wide Web via forums, blogs, social networks and content-sharing services is not structured which leads to the rise of fields like opinion mining, text analysis and sentiment analysis. This paper discusses the different methods of sentiment analysis and highlights its importance in understanding customer reviews to assess text analytics. Since reviews based on sentiment analysis have been included so this paper will focus on reviewing some previous review works of sentiment analysis for customer reviews.

Keywords

Sentiment Analysis, Feedback, Text analytics, Opinion Mining

1. Introduction

Sentiment analysis or opinion mining (part of text mining), as it is sometimes called, is one of many areas of computational studies that deal with opinion-oriented natural language processing. Such opinion-oriented studies include, among others, genre distinctions, emotion and mood recognition, ranking, relevance computation, perspectives in a text, text source identification, and opinion-oriented summarization. Sentiment analysis (or more specifically, sentiment polarity analysis) can be defined as the mapping of text to one of the labels (elements) taken out of a pre-defined set or placing it on the continuum from one end to the other. The elements of the pre-defined set are usually 'negative' and 'positive', but they can also be any other elements such as 'relevant' and 'irrelevant', 'in favour of' or 'against', or other more than two elements such as 'negative', 'positive', 'neutral' or a range of numbers such as from 1 to 10.

Recently, authors developed sentiment analysis methods that can be used across multiple domains like movie and product reviews, election result prediction; disease outbreak, stock market etc. All problems in opinion-oriented text analysis can be formulated as problems of text classification. Thus sentiment analysis can be redefined as a classification of a textual entity into one of the elements or another of the predefined set described above. Sentiment analysis can be done at various levels - document, section, paragraph, sentence, or phrase levels. Most of sentiment analysis work is done at a document level, but there are works on sentiment analysis at the phrase and at sentence levels. Studies have shown that sentiment analysis at the phrase level proved to be more difficult than at higher levels. Quite a bit of early Sentiment Analysis examine centered around item product reviews, for example, items on Amazon.com, characterizing opinion as either positive, negative, or unbiased. These were advantageous marked information, as star evaluations were utilized as quantitative pointers of the creator's assessment. Afterwards, annotated datasets were made for platforms, for examples, online journals, website pages and news articles. Late

development of Twitter has created plenty of research following subjects and estimation for a wide range of new applications: for example, try to predict box-office revenues of movies, track H1N1 epidemics, and monitor effects of an earthquake, all using Twitter. Although exciting in their diverse applications, most sentiment analysis studies have focused on one social media source, tailoring their approaches to a subset of a wide variety of texts. Furthermore, analysis of political discussions proves to be quite challenging, putting in question whether conceptualization of sentiment and lexicon-based approaches developed for mining product reviews are suitable for analysis of such rich discourse. This paper focuses on reviewing the different sentiment analysis methods to help users gather the best information about any particular product they desire, based on other customers reviews, and help in making a decision about any product. This approach helps in opinion mining and helps to review all the benefits and drawbacks of the methods in sentimental analysis.

Existing research works

Akter & Wamba (2016) discussed an approach to encapsulate all the methods that shape BDA functionalities. They also show that BDA will increase business growth once all the characteristics and drawbacks are handled well. Mali et al. (2016) proposed a method to provide direct sentiment analysis results. It helps users to collect the best possible information about the service or product they wish for depending on other customer's reviews. Fang & Zhan (2016) used online reviews from Amazon.com to solve the problem of sentiment analysis and sentiment polarity classification. Vinodhini & Chandrasekaran (2012) showed a survey of all the methods and approaches in sentiment analysis and challenges in this domain.

Mostafa (2013) performed research using a random sample data of around 3516 tweets to assess the customer's sentiment for well-established brands including Nokia, T-Mobile, IBM, KLM and DHL. The analysis was carried on 6800 seed adjectives. Liu (2012) performed research on determining review helpfulness. Review sites need to provide good review ranking to guide the reader with quality suggestions. The quality and distribution of positive and negative viewpoints play a very significant role. Any robot or human spammer can use the helpfulness button to maximize the helpfulness of the review.

Gamon et al. (2005) proposed a prototype system, Pulse done mining and sentiment orientation from free text customer feedback. Khan et al. (2003) presented a review of the unsupervised methods of opinion target recognition from unstructured reviews. The hybrid patterns based candidate selection showed great enhancement in the positive. Liu & Zhang (2012) introduced and explored the field of sentiment analysis and opinion mining. Ordenes et al. (2014) have discussed linguistics-based text mining for developing an enhanced framework. Melville et al. (2009) presented a combined structure where using lexical information becomes useful based on top-class associations and using it in any available training examples. Lee et al. (2008) surveyed and analyzed numerous techniques that are designed for the main tasks of opinion mining. Jebaseeli & Kirubakaran (2012) provides a complete survey on sentiment analysis or opinion mining based on customer's feedback.

Delmontte & Pallotta (2011) suggested any system needs a deep linguistic processing technique to collect opinion and sentiment found in texts or dialogues. Lee (2007) modeled the database of the online consumers' reviews as a matrix of reviews making the relationship between the consumer needs to product specifications. Kasper & Vela (2011) represented a system that gathers user reviews and comments on hotels and designs a more categorized and structured overview. Abulaish et al. (2009) presented an opinion mining system to identify product features and opinions from feedback reviews on the web. Qi et al. (2016) proposed an automatic filtering model to predict the usefulness of online reviews from the product designer's perspective and applied KANO method to show the effectiveness and productivity of the approach. Yadollahi et al. (2017) presented the state of art methods to present a different and innovative view on the literature of sentiment analysis with an aim at emotion mining. Padmaja & Fatima (2013) performed a survey on the field of sentiment analysis and opinion mining by showcasing the basic definitions, varied methods, different evaluation methods, a wide range of applications to the usage of a variety of NLP tools. Jin et al. (2016) illustrated a framework to choose a pair of opinionated representative yet comparative sentences with particular product characteristics from reviews of competitive products. Aguwa et al. (2012) developed a new

method to interpret and analyze the voice of the customer by converting textual and qualitative data to a common qualitative format and later on mapped to CSR. Jeyapriya & Selvi (2015) proposed a system based on phrase level to evaluate customer reviews. Moghaddam (2015) proposed a method to automatically extract defects and enhancements from customer's feedback. Buche et al. (2013) have surveyed and analyzed the various techniques that manage the crucial tasks of opinion mining. Khan et al. (2010) proposed extracts the subjective sentences from the reviews and label each sentence as either positive or negative through Naive Bayesian classifier. Mouthami et al. (2013) used the document level classification to predict movie review.

2. Related works

The main problem in sentiment analysis is the classification of sentiment polarity. [10,32] Whenever a piece of written text is given the problem arises whether to categorize the text into one particular polarity, positive or negative or neutral. There are three levels of sentiments polarity classification namely the document level, the sentence level and the entity aspect level [33]. [1] presents an exploratory framework to study the features and drawbacks of big data analytics(BDA) in the e-commerce business. It overall provides deep insights into the analytics part of the e-commerce business. [2] Illustrates the existing methods for performing sentiment analysis of the customer reviews and has shown which method gives the best result. A semi-supervised approach is followed where opinion words are recognized using WordNet. The sentiment analysis is done in sentence level using Naive Bayes probabilistic model. In [3] a generalized method of sentiment polarity classification is designed with complete product details. The online reviews were collected from Amazon.com [4] presented a summary of the benefits and drawbacks of the approaches in sentiment analysis and suggested more works to be carried out dealing with negation expressions.[5] discussed research using a random sample data of around 3516 tweets to assess the customer's sentiment for well-established brands including Nokia, T-Mobile, IBM, KLM and DHL. The analysis showed a positive consumer sentiment for numerous well-known brands. In [6] review sites need to provide good review ranking to guide the reader with quality suggestions. The quality and distribution of positive and negative viewpoints play a very crucial role.[7] presented a simple prototype system, Pulse to cluster sentences.[8] discussed a review of the state of the art unsupervised approaches for opinion target recognition.[9] presented an abstract of sentiment analysis and provided a common structure to combine various research directions in the domain of sentiment analysis and opinion mining.[10] discussed a framework for linguistics -based text mining modeling to develop an enhanced framework.[11] developed a useful framework to incorporate lexicons in supervised learning for text classification and the developed approached is applied to sentiment classification.[12] provided a complete picture of the techniques and methods required in developing an automated system for mining opinions found in customer reviews on the Web.[13] provides a complete analysis of sentiment analysis or opinion mining based on customer's feedback.[15] suggested any system requires a deep linguistic processing technique to collect opinion and sentiment found in texts or dialogues.[16]designed the database of the online consumers' reviews as a matrix of reviews making the relationship between the consumer needs to product specifications.[17]showed a system that gathers user reviews and comments on hotels and designs a more categorized and structured overview.[18]discussed an opinion mining system to identify product features and opinions from feedback reviews on the web.[20]proposed an automatic filtering model to predict the usefulness of online reviews from the product designer's perspective and applied KANO method to show the performance efficiency and productivity of the approach.[21]presented the state of art methods to explain a varied and innovative view on the literature of sentiment analysis with an aim at emotion mining.[22] showed a survey on the field of sentiment analysis and opining mining by focusing on the basic definitions, varied methods, different evaluation methods, a wide range of applications to the usage of a variety of NLP tools.[23]discussed a framework to choose a pair of opinionated representative yet comparative sentences with particular product characteristics from reviews of competitive products.[24] designed a new method to interpret and analyze the voice of the customer by converting textual and qualitative data to a common qualitative format and later on mapped to CSR.[25] proposed a system to evaluate customer reviews by using

aspect extraction through frequent item set mining in customer product reviews and mining operations.[26] automatically extracts enhancement requests and defect reports from customer feedback.[27]analyzed the various techniques that manage the crucial tasks of opinion mining.[28]enhances the sentiment classification polarity on sentence level unlike the word level lexical feature based work, by the focus on sentences, this also concentrate on contextual information. It proposed extracts the subjective sentences from the reviews and label each sentence as either positive or negative through Naive Bayesian classifier. [29] used a new algorithm called Sentiment Fuzzy Classification along with the document level classification to predict movie review.

3. Different methods of sentiment analysis

In this section, we have considered several classification models to check the efficacy of the recognized features for subjectivity analysis of review documents. We have considered three different classifiers, Naive Bayes (NB), Support Vector Machine (SVM), maximum entropy (ME), k-nearest neighbour (k-NN) and their used 10-fold cross-validation for sentiment classification evaluation.

Naïve Bayes (NB): Naive Bayes is a simple technique for designing classifiers: models that allocate class labels to problem instances shown as vectors of feature values, where the class labels are drawn from some finite set. A Naive Bayes classifier takes each of these features to contribute independently to the probability that this fruit is an apple, regardless of any possible correlations between the color, roundness and diameter features. An advantage of Naive Bayes is that it only requires a small amount of training data to estimate the parameters necessary for classification.

Support Vector Machine (SVM): In machine learning, support vector machines (SVMs, also support vector learning algorithms that network) analyze are supervised data and learning models recognize with associated patterns, used for classification and regression analysis.

Maximum Entropy (ME): The principle of maximum entropy states that, subject to precisely stated prior data (such as a proposition that expresses testable information), the probability distribution which best represents the current state of knowledge is the one with the largest entropy. Take precisely stated prior data or testable information about a probability distribution function.

k-Nearest Neighbors (k-NN): The k-Nearest Neighbors algorithm (or k-NN for short) is a non-parametric method used for classification and regression. The output is dependent on whether k-NN is used for classification or regression. In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbours, with the object being assigned to the class most common among its k nearest neighbours (k is a positive integer, typically small). If $k = 1$, then the object is simply assigned to the class of that single nearest neighbour. In k-NN regression, the output is the property value for the object. This value is the average of the values of its k nearest neighbours.

4. Role of sentiment analysis for customer feedback analysis to text analytics

The amount of unstructured data produced by customers in E-commerce websites increased dramatically during the phase known as Web 2.0. Customers'opinions represent a valuable and important type of information which should not be neglected or ignored by the e-commerce industry. From the customer perspective, considering other users' opinions before purchasing a product is a common behavior long on the Internet. According to Liu(2010), various survey agencies claimed that 70-90 % customers buying decisions are influenced by online reviews through this E-commerce websites customer has access to thousands of opinions, which significantly improves decision making. This feature shows that customer reviews are proven sales drivers. The basic intention of customers is to find the best for the lowest price or purchase that products which fulfill their needs inside a price range by analyzing other opinions come from their neutral nature, which will definitely benefit them. These opinions are usually not linked to an organization or company.

These opinions represent the voice of ordinary consumers, and that differs greatly from advertisements. From these opinions, customers can easily understand the positives and negative aspects of the product. From the e-commerce perspective, receiving consumer reviews/feedbacks can significantly improve its business action plan in order to increase profits. These reviews help in gaining business intelligence and improving customer satisfaction. It is common to find products with millions of opinions, thus, it could be a hard task for a customer to analyze all of them. Sentiment analysis tool and social media analyst's platform help the customer in decision making.

Sentiment analysis is important for businesses because it identifies ways for them to improve their operations and the products they offer. According to various business analyst, customer reviews are the new battleground for brands. E-commerce industries should raise their social media footprint because their success truly depends on the effectiveness of their social engagement action plans. It is very important to get information about what your customers'likes, dislikes, wants and their needs. Sentiment plays an important role to gain advantages over other techniques or policies and helps in improving market strategy.

4. Comparison of the recent techniques

The comparison provides the various research methods that were proposed by different researchers along with their performance results.

Reference no	Paper title	Method used	Advantages	Disadvantages	Future work
2	SENTIMENT ANALYSIS OF PRODUCT REVIEWS FOR E-COMMERCE RECOMMENDATION	A semi-supervised approach is proposed to give meaningful opinion words identified using WordNet.	It collects the best information about any particular a product they desire, based on other customers reviews,	Limited to meaningful words	Future works include sentiment analysis at sentence level using NLTK with Naïve Bayes probabilistic model.
3	Sentiment analysis using product review data	A generalized method for sentiment polarity categorization	It handles the problem of sentiment analysis, sentiment polarity categorization.	It needs to be improved to make it spam free	Future work includes improvement to be spam free
7	Pulse: Mining Customer Opinions from Free Text	A prototype system, code-named Pulse	It only requires the user to identify a small seed word list with known strong and frequent sentiment terms.	There is an additional task for the user to verify and edit an extended seed word list that the tool will automatically	Future work includes improvement of the proposed system to solve the additional task of user verifying the

				produce.	extended words.
10	Analyzing Customer Experience Feedback Using Text Mining: A Linguistics-Based Approach	An advanced linguistics-based text mining modeling to inform the process of developing an improved framework.	It shows high accuracy levels and provides flexibility through training.	It is specific to the situation and the type of service in which the research was done. It results in low data capture rate.	Future research work includes investigation on information gathered from a text mining process to get integrated into company information systems.
11	Sentiment Analysis of Blogs by Combining Lexical Knowledge with Text Classification	An effective framework for incorporating lexical knowledge in supervised learning for text categorization.	It gave better results as compared to using a lexicon or the training data separately, in a semi-supervised setting.	It has the burden of labeling several examples in the target domain.	Exploiting alternative sources of background knowledge in analyzing blogs can be studied further.
16	Needs-Based Analysis of Online Customer Reviews	The knowledgebase of online customer reviews as a matrix of reviews relating customer needs to product attributes	It promises few modest gains in acquiring customer needs	The graph produced is not very suitable to encode synonyms, metonyms,	Future work includes a cluster of synonyms or metonyms' to improve the underlying rule support.
17	Sentiment Analysis for Hotel Reviews	A web-based opinion mining system for hotel reviews	It detects and retrieves reviews on the web, to classify and analyze them, and to produce	It is beneficial to improve the coverage of the IE system	Future work includes the demarcation of evaluative and neutral text as well as to

			comprehensive overviews of these Comments.		the handling of multi-topic segments, especially for the user interface.
18	Feature and Opinion Mining for Customer Review Summarization	An opinion mining system to recognize product features and opinions from review documents	It produces a feature-based summary of review documents in a graphical way.	The grammar needs to be improved to accommodate more dependency relations.	An ongoing project includes a query-answering system to handle opinion-based queries over review documents
20	Mining Customer Requirements from Online Reviews: A Product Improvement Perspective	An automatic filtering model to predict the useful nature of online reviews from the product designer's perspective along with KANO method	The proposed method is very effective and robust.	There may exist numerous preferences among different types of market segmentation	Conducting a clustering process prior to the preference measurement may give a way to improve our model in the future
23	Identifying comparative customer requirements from product online reviews for competitor analysis	A framework for mining comparative viewpoints from product online reviews	It evaluates the similarity between sentences.	-----NA-----	Future works include visualizing the results obtained in an interactive graphical user interface and comparing products with the help of big opinionated product reviews in QFD

24	Voice of the customer: Customer satisfaction ratio-based analysis	A new approach to clearly interpret and analyse the voice of the customer	The design engineers concentrate on the problems of the current product or service instead of waste time and money on fixing insignificant product issues	The current CSR threshold is only zero	Future work includes minimizing the necessity of intervention by domain experts would help to automatize the whole process
25	Extracting Aspects and Mining Opinions in Product Reviews using Supervised Learning Algorithm	Phrase-level opinion mining	Sentiment orientation gives a suitable accuracy.	Only the number of positive and negative opinions in review sentences is calculated.	Future works include the aspects depending on the relative importance of the extracted aspect.
29	Sentiment Analysis and Classification Based On Textual Reviews	Sentiment Fuzzy Classification algorithm	It enhances the classification accuracy on the benchmark dataset of Movies reviews dataset.	It concentrates only on positive and negative reviews.	Future work needs to be done for neutral or mixed reviews.

5. Conclusions

Various sentiment analysis methods are reviewed in this work by combining web mining techniques with computational intelligence for collecting opinions through websites, social media, company data analysis and customers in hotel management application. New opinion mining algorithms are reviewed in this work to collect customer opinions from websites and classify those using existing data mining techniques. New algorithms proposed for sentiment classification and sentiment analysis by extending classification algorithms such as support vector machines, neural networks, decision trees and Naïve Bayes are discussed. Sentiment analysis has been carried out considering words that express positive sentiments -happy, sweet, nice, good and tasty - as well as negative sentiments, which in this work, sentiment analysis has been carried out to provide suitable prediction for successful decision making, using sentiment-based emotional words as well as words implying sentiments. Moreover, sentiment analysis has been used in this work to determine the attitude of customers through online feedbacks given by them on products, hotel services and educational institutes.

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