A Study on Classification Techniques based on Opinions

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Abstract. Sentiment analysis or opinion mining is one of the considerable undertakings of Natural Language Processing. Sentiment analysis is a quick-growing investigation area in computer science. It includes a way of improvement for the collection and assessment of comments or opinions about legislation, laws, and opinions of products, and so forth, which are posted on the internet. Opinion mining analyzes the opinions given by people. In sentiment analysis, the customer feedback, review, shopping site review, online purchase reviews, politics opinions are considered for the analysis. Sentiment analysis is about detecting the emotions i.e. sad, happy, angry, excited, etc. The main objective of opinion mining is characterizing what the public think and comment. This review paper features certain discussions concerning the opinion-based classification and used approaches for the extraction of feeling assessment and opinion mining. Paper presents a comparison between different classification techniques. Applications and challenges of opinion mining are also discussed in this paper.

Keywords: Opinion Mining, Sentiment Analysis, Approaches, Challenges.

1. Introduction

Sentiment analysis mainly refers to written text or review given by users which are based on opinions, emotions, and attitudes. Sentiment Analysis fundamentally expects to comprehend the public opinions and it conveys them into categories like negative, positive, or neutral. In a recent area of research, most of the work of sentiment analysis has been done over review sites. Sentiment analysis is mainly applied to analyze the response of customer, marketing, healthcare application. Sentiment analysis is useful to detect customer feedback any shopping sites. The shoppers assume a significant job in the web-based business world and they have diverse buying propensities contrasted and customary purchasers. Organizations must focus on online buyers’ needs, propensities, and ways of life and qualities to fulfil them in an increasingly worldwide, serious, and dynamic condition. Opinion mining and opinion investigation dispatch to the kind of natural language processing, content assessment, and computational semantics to recognize and isolate passionate information in source material [3]. Sentiment analysis is broadly used to mine abstract data from content on the internet, including writings, tweets, online journals, web-based social networking, news stories, reviews, and comments. Sentiment permits associations to perceive customer evaluation toward items, brands, or organizations in online conversations and input.
Motivation: The quality of the product can be improved by analyzing the sentiments, reviews, or opinions of the product. Opinions regarding the product help the user to decide on the purchase. Consumers and producers highly value customer’s opinions about products and services.

Objectives: This paper presents a review of the done by analysts in the area of opinion mining or sentiment analysis. The goals of this paper are depicted as follows.

- To present an assessment dependent on the past work done in the field of opinion mining or sentiment analysis.
- To find out the best classification technique for mining opinions or sentiments.

This paper is described in five sections. The first section of the paper describes the brief introduction about the opinion mining or sentiment analysis. The motivation and objectives of the paper are described in this section of the paper. The rest of the paper is composed as follows. The second section of the paper describes the data sources and approaches to sentiment analysis. The third section of the paper describes conversations about the work done by the different analysts in the field of opinion mining and sentiment analysis. Applications and challenges of opinion mining are described in the fourth section of the paper. The conclusion of the paper is described in the fifth section of the paper.

2. Data Source and Approaches of Sentiment Analysis

This section describes the brief information about the data sources of sentiment analysis and about the approaches of sentiment analysis.

2.1. Data Sources for Sentiment Analysis:
Social media is enormously used in the era of internet. Data generated from these social networking websites or services can be used in the marketing, prediction and in the analysis of opinions. Mining of opinions or reviews from the social media content is attracting the large segment of business. Many data sources are available on Web e.g. blogs, social sites, etc. The different sources of data are described below.

Twitter: Twitter is a social networking service through which one can send posts, interact with other persons. The messages of this service are known as “Tweets”.

Facebook: Facebook is social networking service in which one can post the text, photographs and multimedia which is shared with the others. Clients can see the profiles of different clients.

Feedback Forms: A feedback form is a manner in which client analysis is obtained. Analysis structures help in improving things or benefits, and even the significant perception of the business customers. The organization utilizes client input to improve its items.

Wikipedia: Wikipedia is free online encyclopaedia. Wikipedia articles permits the client to utilize joins that are identified with the page for extra data. The Wikipedia requests to a wide range of kinds of individuals.

Bookmarking: Bookmarking is an online assistance that permits to make and openly share site bookmarks with different individuals from a network by basically labelling a site page.

2.2. Approaches to Sentiment Analysis:
Artificial intelligence is the logical investigation of sentiment examination was performed by utilizing a way of AI procedures, model, and Natural Language Processing for extremely huge information extraction [22].
Due to the capability to handle the enormous amount of data and automatic implementation makes the machine learning as extensively used sensible approach under opinion mining. Approaches of opinion mining are classified as machine learning approaches and Lexicon based approaches as shown in Figure 1. Machine learning approaches are categorized as supervised and unsupervised type. These are briefly described in this section of paper.

**Supervised learning:** Supervised learning is learning in which machine is trained based on input data that are labelled with the desired output [19].

![Figure 1. Sentiment Analysis Approaches](image)

1. **Decision trees:** It is the supervised learning algorithm that tries to solve the problem. The decision tree is the most useful machine learning tree structure. It isolates a dataset into smaller. It is easy to explain and it brings about a lot of rules. The highest choice hub in a tree which analyzes to the best pointer called root point. Decision trees can manage both categorical and numerical information.

2. **Bayesian classifiers:** Bayesian classification depends on Bayes' Theorem. Bayes' theorem is used to estimate the incidence of any event. Bayes’ Theorem finds the probability of an incident happening given the probability of that has just happened. Naive Bayes classifier is highly scalable and they are an extremely well-known technique used in text categorization [27].

3. **Maximum Entropy:** Maximum Entropy order is a strategy that has shown compelling in several natural language processing applications. It doesn't make any assumptions about the associations
between features, so may conceivably perform better when restrictive autonomy speculations are not met. The limit estimates are set to boost the entropy of the incited flow subject to the basic that the typical estimations of the element/class capacities as for the model are equivalent to their normal qualities as for the preparation information.

4 Neural networks: Neural network systems are a computational learning framework that utilizes a system of capacities to understand and translate an information contribution of one form into a desired output, usually in another form. A neural network is simply a lot of neurons associated together. A neural network can have quite a few layers with quite a few neurons in those layers.

5 K-Nearest Neighbour: K nearest neighbors is a basic calculation that stores each open case orders new cases dependent on a comparability measure. If K = 1, by then the case is essentially assigned to the class of its closest neighbor.

6 Support vectors machine: SVM is for the most part utilized for the opinion classification. It groups the positive and negative reviews [16]. SVM decides the point that is nearest to one another, its computation is to find a hyper-plane in N-dimensional space that separates the labels [1].

7 Random Forest: Random forest is a supervised learning algorithm that is used for both classifications as well as regression. However, it is basic for characterization issues. Also, understand that a forest is comprised of trees. Additionally, a random forest algorithm creates decision trees on data tests and a while later gets the prediction from every one of them lastly chooses the best arrangement through voting. It is an outfit procedure that is better than a single choice tree since it diminishes the over-fitting by averaging the outcome. Random forests are very flexible and very high accuracy. A Random Forest algorithm keeps up great exactness even an enormous extent of the information is missing.

Unsupervised learning: In unsupervised learning model information is given, it is used information which is not labelled. Unsupervised learning finds all unknown patterns of data and does not need a supervised model. Unsupervised learning is an example of the cluster and association. The objective of unsupervised learning is to show the essential structure or spread in the information to get acquainted with the data. These are called unsupervised learning. Unsupervised learning issues can be furthermore collected into clustering (grouping) and association issues. Clustering- A clustering problem is where want to find the natural groupings in the information, for instance, gathering customers by purchasing conduct. Association- This is an unsupervised method with an unlabeled dataset. An unlabeled dataset is a dataset without a variable that gives us the correct response. For example, an example of association rules is market basket analysis.

Lexicon-based approaches: In this technique a sentiment lexicon to depict the extremity (positive, negative, and nonpartisan) of literary substance. This methodology is more understandable and can be easily implemented in contrast to machine learning-based algorithms. This procedure based can be also isolated into Dictionary-based and Corpus-based.

The dictionary-based methodology includes using a word reference which contains counterparts and antonyms of a word. A straightforward method in this methodology is to use several seed assessment words to bootstrap subject to the equal word and antonym structure of a word reference. Specifically, these procedure capacities as follows: A little arrangement of conclusion words (seeds) with acknowledged positive or negative headings is first accumulated physically, which is very simple. The corpus-based technique helps to solve the issue of discovering feeling words with context-specific directions. The corpus-based methodology finds other sentiment words in an enormous corpus. A hybrid approaches joining the AI and the word reference-based methodologies might be utilized for sentiment analysis.
3. Related work

This section presents discoveries on research and related work for feeling analysis. Many research papers, books and articles related to opinion mining have been studied. We have discussed some of the important research articles.

Kiran Salvi, et al. [2] presented the current twitter investigation, over a method that retrieves image by automatic segmentation technique. The proposed work was done to accumulate the opinions of the customer as for a specific kind of subject. Content-based picture retrieval used visual features such as color, shape, picture height, picture width, forced of shading to speak to the rank the picture, and retrieves picture via programmed division procedure. This type of work demonstrates that the proposed framework was productive and help full to the client to do their shopping successful effectiveness.

Santhosh Kumar, et al. [3] discussed a technique that consequently extricates the conclusion structure site through the opinion form website through the Naive Bayes classifier; logistic regression, and sentiment which help in identify the user’s opinion. Quality metric parameters were measured for the performance of each classifier.

Manoj Kumar Das, et al. [4] proposed the methodology which was primarily utilized for opinion/sentiment task through the natural language processing which helps in extricating that distinguish the client's view.

Fatemeh Hossein-Zadeh bendarkheili, et al. [5] proposed a lexical-based opinion method technique for Persian web shopping that think over the effect of intensifier removing the particular customer's review.

Yenlee Chu et al. [6] presented this exploration depends on Schmitt's key trial modules and Lifestyle theory. Quantitative method was applied, studied made sense of the experiential system, and structured components that were preferred by the purchasers. It was described that the online consumers are classified in three categories e.g. online shopping avoiders, online shopping lovers and fearful online shoppers.

Xing Fang et al. [9] presented sentiment analysis used in item conclusion information in used natural language processing. A sentiment polarity classification process has been introduced and it is partitioned into two sections sentence level arrangement and survey level order preformed.

B. Sabitha et al. [23] discussed a method used frequent item set mining and choice tree, applied this technique the investigation of discount information the information in the dataset was pre-processed to make it sensible for arrangement. The frequent item set was mined from the market basket the powerful Apriori calculation and henceforth the association rules created and acquired high arrangement precision.

Gurneet Kaur et al. [18] viewed and expected a technique introducing a consolidated type of decision trees and Naive Bayes approaches. The hybrid approached for example proposed including spelling correction in review text, and afterword introduced an exact investigation of the efficacy of classifying the polarity of comments given on internet business website by semantic importance. The appropriate and the most ideal outcome incorporate the prevision of incorporating other language words in the dataset for more accurate results, an investigation was given by the ML and the natural language processing composed of classifiers.
Ahlam alrehili et al. [24] examined several techniques of machine learning used in research was voting which combined five classifies: naive bayes, support vector machine (SVMs), random forest, bagging and boosting. All experiments were presented using WEKA. The algorithm proposed gives accuracy which equivalent to 89.87% on account of used unigram. The voting algorithm showed the best execution in different situations.

Marium Nafees, et al. [17] discussed for investigation on polarity classification approached proposed was mainly used for sentiment tasks through the natural language processing that was concerned to identify the opinion inside the content. The stages, weblogs, item review sites, online business, and informal communication sites analyze.

Upma kumari, et al. [16] used the SVM classification technique. Precision, Recall and f-measures were calculated using the experiments based on the analysis of text related to the smart phone.

Alessia D’Andrea et al. [15] concluded that the sentiment analysis approaches can be classified into the machine learning, lexicon based and hybrid approach. Further it was concluded that the hybrid approach which is based on the combination of machine learning approach and lexicon based can possibly improve the presentation. The advantages and limitations of the sentiment analysis approaches were additionally examined.

Suci Laila Ramdhani et al. [22] gathered data from, YouTube and Twitter. Naive Bayes was picked to perform assumption examination since this strategy has a high exactness in different investigations. The outcome indicated that Naive Bayes has a precision rate of over 84% and negative opinion rose by 12.51%.

Sanjeev Prashar et al. [25] applied the concept of stimulus organism response to clarify the Indian purchasers' shopping conduct other than analyzing the significance of structure components in empowering the site's satisfaction.

G. Vinodhini et al. [29] presented a survey covering the techniques in sentiment analysis and challenges appearing in the field. M. Rani, J. Singh [31] highlighted the basic concepts of opinion mining, opinion mining framework, classification techniques, challenges and applications of opinion mining. The summary of the classification techniques based on opinions is described in Table1.

Table1. Comparison of Classification techniques

| Author's Name          | Year | Mining Technology used | Data Source                      | Proposed Work                                                                 | Findings                                                                 |
|------------------------|------|------------------------|---------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Xiaomanliu and Jing li, et al. [1] | 2016 | SVM Classification     | Product recommendation purchase predication. | Introduced their work on 168 features of the crude information with SQL Server for instance of opinion analysis. | To build up a model to predict online purchase behaviour.               |
| Ding Bin, Zhao Dan, et al. [7] | 2010 | SVM, NBM, and ME.      | Reviews of customers from Amazon.cn and Dang Dang which are B2C sites. | Explained the text mining to online customer review mining based on Semantic classification. | The prototype system A model can be a reference for web-based business ventures, to manage and analyze online surveys. |
| Author(s)                  | Year | Methodology                | Dataset/Environment                                                                 | Research/Key Points                                                                 | Findings/Results                                                                 |
|---------------------------|------|----------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| S.A. Sadhana, et al.      | 2017 | Semi-Supervised            | Customer Review Dataset from Amazon.                                                 | Proposed dependent on the semi-administered word arrangement model based on mining target opinion from online reviews. | Using an approach for extracting opinion word alignment model.                  |
| Kiran Salvi, et al.       | 2016 | Sentiment Analysis        | A twitter dataset in reviews collects in the different shopping sites.               | Proposed in exiting system sentiment analysis which of the survey was mainly presented the tweet is positive of negative collected review in different sites. | The proposed system recommends shopping site.                                   |
| Venkata Rajeev, et al.    | 2013 | Natural language processing | Flip kart’s digital camera reviews.                                                  | Created a model web-based and performed the work on cell phone review and compared products sold online using Naïve bayes Classification. | Finally, the outcome of the thing scores as the limit of feature surveys, show a correlation of 2 items to help a customer in picking the right thing. |
| Adee Romadhony, et al.    | 2013 | Hybrid approaches          | Amazon product reviews.                                                              | Presented work on recommendations focusing on Indonesia marker dependent on client action and rating on an item produced algorithm using formula. | The outcome shows that the vast majority of the clients like the thing based suggestions. |
| Zhongie Mao, et al.       | 2012 | Automatic evaluation method | Reviews which have a place with DVD and Blu-beam and are posted to Rakuten Market in 2010 | Proposed procedure initially clear copy and paste overviews, of remaining review demonstration extract evaluative property are extracted. | The improvement of the extraction of articulations referencing evaluative characteristics, just as an examination of survey positioning algorithm. |
| T. Sangeetha, et al.      | 2017 | Aspect ranking method      | Ten different mobile reviews amazon.com                                              | Investigated the online reviews for products based on aspect ranking of aspect dictionary and opinion. | The output aspects ranking based on their sentiment score opinion.               |
| Phoey Lee Teh, et al.     | 2015 | Finer-grained sentiment    | Ten unique kinds of things from the Web-based Media Platform                         | Explained the sentiment analysis which describes the online product review positive negative by using | Contrasted with negative remarks, positive remarks have a lesser number of critical cases. |
| Name                      | Year | Method/Approach                        | Data/Technique                                                                 | Results/Contributions                                                                                                                                 |
|---------------------------|------|----------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Jawad Khan, et al. [19]   | 2016 | Supervised lazy learning               | Amazon data sets of 5 distinctive gadgets items: 2 diverse advanced cameras, 1 wireless, 1 mp3 player, and 1 DVD player. | Introduced a model with a syntactic manual for subjective opinion-based opinion mining and sentiment analysis. Comparison of Hu and Liu’s and technique for thing highlight extraction. |
| Yadong Zhang, et al. [20] | 2014 | Machine learning approaches           | Amazon review in combination like (beauty, Health/Personal Care, electronics item reviews). | Examined several techniques of SVM used in classify utility systems of online comments for a product. Finally outcome the accuracy from different feature combinations based upon to construct a customized support expectation model. |
| Cut Flarani, et al. [21]  | 2016 | Aspects of based Sentiment and Machine learning | Indonesia Online Retail Shop Review. | Examined several techniques of Naïve bayes and Aspect based classification of online retail business. Indonesian distro conclusion investigation framework has a precision exactness pace of 97.24% and a review of 89.86% precision rate. Outcome the improve confront predicament (20 substantial surveys were investigated, with 63% being a man). |
| Chang-Hsien Hau, et al. [26] | 2010 | AHP Method                            | PChome web-based shopping mall and hurray super shopping mall in Taiwan. | Proposed an applying expository Hierarchy Process (AHP) in dynamic administration application. Finally outcome the improve confront predicament (20 substantial surveys were investigated, with 63% being a man). |
| Shivaprasad T K, et al. [27] | 2017 | Naïve bayes (NB), support vector machine (SVM) and maximum entropy (MaxEnt) | Sports, electronic, and Computer reviews. | Proposed an applying mix in supervised learning and unsupervised learning. The process of sentiment analysis is partitioned into three levels: Document Level, Sentiment Level, Aspect level. Finally outcome the different approaches used in classified the review. Sentiment analysis is advancing fast and giving high-quality results |
| Miss. Lovenika Kushwaha, et al. [28] | 2016 | Natural Language Processing | Mobile product datasets. | Presented the natural language processing technique is utilized to get the limit overview and AdaBoost classifier. Collect beneficial data from a great many surveys about items and close them by prescribing the best reasonable items to the clients. |
The inference drawn from the Related Work: Sentiment analysis or feeling mining is a field of study that breaks down individuals' opinions, perspectives, or feelings towards specific elements. We came to know from the reviewed papers that different authors used different techniques for the analysis based on opinions and each classification technique has its advantages and limitations. The following inferences have been drawn from the literature survey.

- In general, the supervised learning methods give the best results than the unsupervised learning and supervised learning method is expensive to implement as these require a labelled set of data.
- Most of the researchers have used the SVM classifier because of better accuracy.
- There are many tools available for the analysis of opinions.
- Random Forest can automatically handle missing data because of this reason many researchers use this approach.

4. Applications and Challenges of Sentiment Analysis

On the basis of literature review regarding classification techniques based upon opinions, it was found that there are many applications and challenges.

4.1 Applications of Opinion Mining

The use of the internet and its acceptance has changed the lifestyle of the persons or customers. The following applications were observed in which opinions or reviews given for any product plays an important role.

Online Commerce: The most general utilization of sentiment analysis is in an e-commerce enterprise. Websites allow their clients to present their experience about shopping and their interpretation of item qualities. They give an outline for the item and various features of the items based score and rating.

Recommendation Systems: By classifying the people’s sentiment into positive and negative, the structure can say which one ought to get suggested and which one ought not get recommended.

Feedback analysis: Customers’ use business feedback about various products and then analyze it to understand whether the consumers are happy with the product or not.

Social media: Social media has seen remarkable development and billions of individuals over the globe use it for sharing thoughts and feedback and trading data with one another. Different web-based

| K.V.Akhil Kumara, et al. [30] | Machine learning approaches | Digital camera reviews from Amazon. | Finally, results are the SVM accuracy 83% and Naive 80% | Proposed two arrangement algorithms, Naïve Bayes Classification and SVM Classification in R Programming language are used. |
media channels like blogs, social networking sites like Face book, Twitter, etc. have made it simpler for individuals to stay connected and updated.

*Product analysis:* The use of opinion investigation in item examination originates from reputation management. Theoretically, it is fundamentally the same as brand observing. By using the opinions, the customer can choose among multiple options by analyzing the reviews of other customers for the products.

### 4.2 Challenges of Opinion Mining

Opinion mining is a developing and ever-powerful field, such dynamism leads to an excessive number of challenges. The challenges faced for the sentiment analysis are described below.

- One of the key challenges for opinion mining is the lack of availability of the labelled data for supervised learning methods.
- There are numerous reviews whose polarity changes from domain to domain.
- The big challenge is about the evaluation of believability of sentiment.
- Opinion mining is the decides the polarity strength of opinion or in the general opinion of many customers As the conversation goes on, may prompt a change in the quality of the supposition or even change the polarity from positive to negative.

### 5. Conclusion

Many research papers have been surveyed on opinion mining, classification techniques, their applications and challenges. Sentiment Analysis or opinion mining has a broad scope and at the same time, it is also facing many challenges. Most of the organizations are working to develop a better opinion mining system. Many algorithms have been developed but none is found perfect which can resolve all the challenges and issues of opinion mining. It is found that SVM performs better as suggested by most of the researchers. But the results can further be improved. One of the methods is to combine the individual classifier which can result in boosting the performance of opinion mining or sentiment analysis.

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