

Blueprint of Emerging Techniques used in Sentiment Analysis

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Abstract—Sentiment analysis is an important application of Natural Language Processing. It is a technique used to find out polarity of the text written in the feedback, comment or review. There are mainly three types of polarity i.e. negative, positive and neutral. Polarities are mainly used in opinion mining, decision making, and extraction of feelings and emotions of the user. Sentiment analysis is mainly used in Internet era where number of applications is available where users can give their remark easily and frankly. Sentiment Analysis works as a dominant tool for users and helps in finding out the needful information and also used to combine the collective sentiments of the reviews. Numbers of methods are available to perform the sentiment analysis. This paper contributes an impression about different methods invented to perform sentiment analysis and gives brief idea about scope of research.

Index Terms— Sentiment, Polarity, Aspect Based, Fine-grained, Decision Making.

I. INTRODUCTION

Social media plays a vital role in growth of today's generation. Everyone is able to use social media flexibly as it is user friendly, having attractive GUI, it reduces our efforts and anyone can put their opinion on any website without intervention. Sentiment analysis (SA) helps to identify the polarity of the objects like Service, Movie, event, Stock Market, different products available on amazon and many more. Sentiment analysis is commonly used for classification of text in binary class or multi-class depends on the problem. We can perform sentiment analysis of Single domain - single language, multilingual- single domain, multilingual-multi domain problems. Many datasets are available online especially for movie reviews, twitter data set and amazon product dataset for evaluating sentiment analysis. Data pre-processing is the first step in sentiment analysis which consist of different steps like remove numbers, Stemming, Part of speech tagging, remove punctuation, convert text to lowercase and remove stop words.

This paper is structured as follows. Section II illustrates overview of sentiment analysis. Section III presents literature review. Sections IV provide comparative analysis. Section V depicts the observation. Section VI sums up the conclusion and future scope.

II. OVERVIEW OF THE SENTIMENT ANALYSIS

A. Types of SA

We can perform sentiment analysis of four different types as shown in Fig.1. There are four main types of sentiment analysis as describe below.

Fine-grained sentiment analysis helps you in analysing the feedback from the input given by the customer and you can get specific result in the form of polarity of the input though it is costly and need more efforts. *Emotion Detection sentiment analysis* is refined way to identify an emotion hide behind the text. Machine learning & Lexicons are used in emotion detection sentiment analysis. Terms get separated according to their sentiment. This is more complex and algorithm based sentiment analysis type. *Aspect-based sentiment analysis* considers the terms related to the different features and identify the sentiment associated with it. It requires feature classes and its equivalent aspect terms to find out sentiment for each aspect from the text. *Intent analysis* is used to predict the intention of the customer whether user wants to use the product or not. Pattern of the intention can be formed and used for marketing and advertising of the product.

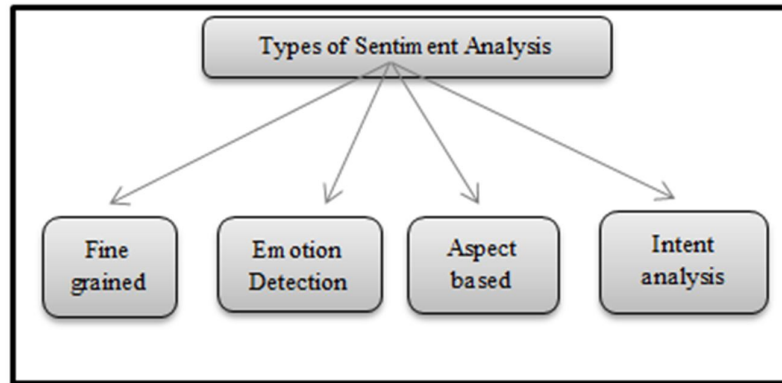


Fig.1 : Types of Sentiment Analysis

B. Models of SA

To guess the sequence of words, language models are used. **Statistical language model is used to study possible distribution of words. Neural language model uses neural network to model the language. Sentiment analysis of user feedback given in** unigram (one-word sentence), bi-gram (two-word sentence), tri-gram (three-word sentence) and n-gram (number of words sentence) sentence is possible [16][23].

C. Datasets used in SA

To perform sentiment analysis, one can create own dataset as per the requirement or can use built in dataset. Web crawlers or APIs are used to fetch the data from the websites. E-Commerce websites like Amazon [20][29], Snapdeal, Jabong, YELP[23][34] etc. have their own data repository. Social media websites like Facebook, Twitter [5][8][9][14] and Instagram have their own API which provides access to data of limited period. Kaggle, Github, Google toolbox, Weibo[2] are the biggest data repositories available on the internet which consist of documents of almost all the domains. Most of the datasets are available in English Language. Dataset for different language datasets are also available. For ex. Douban (<http://www.douban.com/>) is a popular Chinese review site where users can post comments on movies, books and music and give a 1 to 5 star rating [28].

D. Structural Design of SA

Sentiment analyser accepts the data in .xlsx, .csv, .html and .xml, JSON files. Pre-processing consist of the removal of stop words, text cleaning, stemming and lemmatization, clarity of words, syntax and grammar, POS tagging, tokenization [38]. Feature extraction is the process of mining language model of text. In dataset creation process, actual dataset get generated on which designed algorithm get implemented. Output gives result either in the form of polarity of the text or in some other expected form depends on designed algorithm. Structural design of SA is as shown in Figure 2.



Fig. 2 : Structural Design of SA

E. Applications of SA

Sentiment analysis is used to enhance the quality of the product and help to monitor the social media. Cross domain sentiment analyser can be designed for multilingual input using which user can make his own decision based on ratings and feedback. As polarity is known, sentiment analysis saves the time in making decisions. It is also useful in forecasting of stock market.

III. LITERATURE REVIEW

To perform the sentiment analysis different methods are being used. Following section gives the brief review of different methods used to perform sentiment analysis in natural language processing.

Qing, Jianwei et al. [1] have designed eWOM exploring method for analysis of the customer reviews in social media and e-commerce websites which gives valuable input to other customers about the product. Da, Rafal et al. [2] have designed HEMOS means Humor, Emoji and slang system using Weibo social media. Reinald et al. [3] designed an innovative method to generate summaries of various online reviews which is further divided into sentiment classification and aspect extraction.

J. Xie, B. Chen et al. [4] proposed a method which is designed to solve the hassles of in what way contextual information and semantic features should use and how to make association between context words and aspect terms which also includes opinion terms. P. Sharma et al. [5] stated that machine learning works well in prediction of public sentiments from the social media. Kashfia et al. [6] have developed personalized recommender system to analyse emotion and sentiment for social media. Author analysed six emotions namely anger, disgust, fear, joy, sadness and surprise which is characterized by different dimensions using replies from tweets.

Yasuto, Yuji et al. [7] developed sentiment analysis method which extracts sentiment from voice of customer and made a suggestion as sentiments should be constantly evaluated. Neha, Nirmalya et al. [8] showed that sentiment analysis of twitter data is helpful to improve action plan and rescue operations in emergencies like natural disasters, natural calamities or any other artificial emergency. Klaifer et al. [9] developed a method for topic identification using topic modelling and sentiment analysis of COVID twitter data. Achini, Gihan et al. [10] proposed complete framework for self-structuring AI for emotion modelling. Charalampos, Faiyaz et al. [11] presented an emotion modelling method to integrate human emotion with smart computer systems using fuzzy logic technique.

G., H. et al. [12] built an extended sentiment dictionary which contains basic sentiment words, domain sentiment words and poly-semantic (words having multiple possible meanings) words. Manar et al. [13] Researcher found that one way ANNOVA method not gets used in previous studies in sentiment analysis. It is found that SVM and Naïve Bayes Algorithm work well with One Way ANNOVA. Akilandeswari et al. [14] proposed scoring methodology to calculate the polarity of sentiments of twitter message containing emotions, non-language features and abbreviated words. K. Zahoor et al. [15] perform the classification of customer reviews about different restaurants.

Deepali, Manju et al. [16] designed dictionary resource for Hindi Language for two domains. Lo, S.L., Cambria, E., Chiong, R. et al [17], proposed a framework which is applicable for scarce resource languages. Yang, Xiong et al. [18] this paper shows that sentiment analysis is useful in decision making and proposed a method for online purchase decision using sentiment classification and discrete DIFWA operator considering preferences of dynamic information. P. Ji et al. [19] found that in previous research scaling criteria and revision was not taken into account which is an important chunk of online reviews. Hence author suggest and implemented probability multivalued neutrosophic linguistic number (PMVNLN) concept to depict online reviews. R. Zhang et al. [20] observed that current approaches used in emotional text generation frequently suffer difficulty of requiring marked data. To avoid mentioned problem, author proposes a model called as Generative Adversarial Network - based cross-domain text sentiment transfer model which provide support to train emotional text generation network.

Mohammad, Syeda et al. [22] developed an algorithm for sentiment analysis of emoticons with text and found that deep learning algorithms give better performance as compared to machine learning algorithms. Vraj,

Sidarth et al. [24] proposed a system using neural network classifier to perform text analysis. Jyoti et al. [25] found that word correlation is very difficult task for sentiment analysis of multiple domains. Hence, author proposed a system which extracts and classifies opinion words from one domain and suggests predicted word for other domain. M. Lutfullaeva et al. [27] found that along with the text polarity, emotion polarity also plays an important role in sentiment analysis and hence author proposed a method which is a combination of three approaches namely rule-based approach, dictionary based approach and supervised learning approach. Yanxia, Fangna et al. [28] observed that polarity of the word may change depends on the context. Context and Aspect Memory Network method is introduced during research at aspect level. K., A. et al. [29] suggested that, broad image of the product is obtained if feature level rating from customer reviews is performed. Author proposed four step methodologies which include feature selection, pre-processing, relevant sentence extraction and feature based rating generation.

Xie et al. [30] defined three models namely customer rating model, product ratings model and time series model to analyse success or failure of the product. Wang, Bingkun, et al. [31] proposed review rating prediction method which is based on user and product perspective along with user and product review. Bancken, Wouter et al. [32] New aspect based sentiment analysis approach Aspectator is proposed to summarize the most positive and most negative reviews related to specific product.

IV. COMPARATIVE ANALYSIS

Findings of literature review are given in Table 1. Table gives you a brief idea about type of sentiment analysis, dataset used in research, language of the dataset, and future research scope possible.

TABLE I: COMPARISON ANALYSIS OF LITERATURE REVIEW

Ref. No.	Title of the paper	Type of Sentiment Analysis	Dataset	Language used	Limitations
1	Exploring eWOM in online customer reviews: Sentiment analysis at a fine-grained level [2019]	Fine Grained	Mobile customer review	Chinese	Continuous improvement of opinion words extraction and polarity computation
2	HEMOS: A novel deep learning-based fine-grained humor detecting method for sentiment analysis of social media [2020]	Fine Grained	7.6 million posts from Weibo API	Chinese	Identifying spammers from posts and study of newly added features related to emotion
3	An adaptable fine-grained sentiment analysis for summarization of multiple short online reviews [2017]	Fine Grained	Movie and Product	Korean, Chinese, English	Analysis of twitter data for extraction of aspects and sentiments and use them in summarization
4	Self-Attention-Based BiLSTM Model for Short Text Fine Grained Sentiment Classification[2019]	Fine Grained	Restaurant, laptop and Twitter	English	Expansion of accuracy sentiment polarity classification. Attention mechanism and Mathew effect can also get implemented.
5	Experimental investigation of automated system for twitter sentiment analysis to predict the public emotions using machine learning algorithms	Emotion Analysis	Review sites Blogs Micro-blogs Twitter Social network	English	Simulation of ML techniques to investigate performance parameters such as precision, recall, accuracy and F1-score
6	Emotion and sentiment analysis from Twitter text[2019]	Emotion Analysis	Own Dataset using Hash tags on Twitter	English	Current system is static. We can design dynamic recommender system which will provide suggestions on any topic.
7	A Consideration of Evaluation Method of Sentiment Analysis on Social Listening [2019]	-	Py Thai NLP	Thai	Perfection of existing method
8	Analysing The Emotions of Crowd For Improving The Emergency Response Services [2019]	Emotion Analysis	Dataset of Las Vegas Shooting	English	Implementation using Supervised ML approach (with labelled data) and DL approaches to get the precise accuracy and dynamic model
9	Topic detection and sentiment analysis in Twitter content	-	COVID 19 dataset from	Portuguese and English	Implementation of different algorithms written in

	related to COVID-19 from Brazil and the USA [2021]		tweeter		Portuguese and other languages.
10	A self-structuring artificial intelligence framework for deep emotions modelling and analysis on the social web [2021]	Emotion Analysis	Data collected from Mental Health Forum	English	Exploration of emotion dynamics on digital platform is possible so that gritty and multifaceted user's behaviour can get identified.
11	A fuzzy computational model of emotion for cloud based sentiment analysis [2018]	Emotion Analysis	Online Survey	English	Modification of proposed method using FCM and bio-inspired optimization to improve parameters of existing model.
12	Chinese Text Sentiment Analysis Based on Extended Sentiment Dictionary [2019]	-	Hotel, Digital, Fruit, Clothing and Shampoo	Chinese	Algorithm to calculate weights of active and passive words and sentiment words along with design of sentiment classifier
13	Improving Sentiment Analysis of Arabic Tweets by One-way ANOVA [2020]	-	Twitter	Arabic	Implementation of one way ANNOVA method along with binary classification problem
14	Sentiment Classification of Tweets with Non-Language Features [2018]	Feature Level	IPL, Cricket, Commonwealth Games, Parliament Election	English	To investigate the performance of classification integration of statistical techniques
15	Sentiment Analysis and Classification of Restaurant Reviews using Machine Learning [2020]	Classification Of text	SWOT's guide	English	Implementation of Neural Network and DL algorithms
16	Context Specific Lexicon for Hindi Reviews [2016]	-	Movie and Hotel	Hindi	Use of Context Specific polarity Lexicon to improve the classification accuracy
17	Multilingual sentiment analysis: from formal to informal and scarce resource languages [2017]	-		English	Development of Hybrid framework
18	A Decision Method for Online Purchases Considering Dynamic Information Preference Based on Sentiment Orientation Classification and Discrete DIFWA Operators [2019]	-	Five different mobile phone brands	Chinese	a) Investigation of classification of sentiment words. b) Integration of existing system with different types of fuzzy sets.
19	A Fuzzy Decision Support Model with Sentiment Analysis for Items Comparison in e-Commerce: The Case Study of http://PConline.com [2019]	-	Real dataset from PConline.com	Chinese	Reducing complexity of existing model
20	Emotional Text Generation Based on Cross-Domain Sentiment Transfer [2019]	Emotion Analysis	Yelp and Amazon	English	To apprehension semantic link between different domains network expansion.
22	An algorithm and method for sentiment analysis using the text and emoticon [2020]	-	Airline Review Twitter dataset	English	Research can be extended for Multilingual dataset.
24	Text-Based Intent Analysis using Deep Learning [2020]	Intent Analysis	Own Dataset	English	Expansion of the dataset is suggested which includes Emojis, lingo which can target large audience.
25	Entropy based classifier for cross-domain opinion mining [2018]	Cross Domain	Books, DVDs, Electronics and Kitchen	English	Clustering of documents and words from different domains. Along with implementation on bigram, trigram and n-gram text in other languages.
27	Optimization of Sentiment Analysis Methods for classifying text comments of bank customers [2018]	Classification of text	Review of Bank Customer	English	Improvement of the result with better classifier.

28	Aspect-level sentiment analysis using context and aspect memory network [2021]	Aspect Analysis	Laptop and the restaurant dataset	English	Method can implement further on vectors on Aspects containing multiple words and to recognize implicit feature.
29	Feature-Level Rating System Using Customer Reviews and Review Votes [2020]	Feature Level	Mobile Dataset	English	Feature level Rating system can be implemented using weakly supervised or unsupervised approach.
30	Analysis of online shopping reviews based on natural language processing – Taking Amazon as an example [2021]	-	Three products of sunshine company	English	More research work on Smart Marketing and timely updates of product is expected.
31	Review rating prediction based on user context and product context [2018]	-	Douban movie review, restaurant(Yelp) , Books & Music	English & Chinese	Model containing affection of user context and product context is yet to be done to improve the performance of RRP.
32	Automatically detecting and rating product aspects from textual customer reviews [2014]	Aspect Analysis	Movie & MP3 reviews from Amazon	English	Learning of dependency paths for multiple domains is yet to be thru.

V. OBSERVATION

During literature review, it is observed that there are some standard steps followed by the researcher while doing sentiment analysis of any type in any domain and in any language. These steps are depicted in Fig. 1.

Natural language processing mainly works in domains like Information Retrieval, Machine Translation, Opinion Mining, and Sentiment Analysis. As shown in Fig.1, Fine grained, Emotion Analysis, Aspect Analysis and Intent Analysis are four types of sentiment analysis. To perform research, data get collected from different domains and in multiple languages which gets fitted into different models. Data pre-processing should be done on the collected data. Finally, compare the proposed algorithm with machine learning algorithms and check the accuracy of the proposed method.



Fig. 3 : Standard steps to perform Sentiment Analysis

VI. CONCLUSION AND FUTURE SCOPE

Sentiment Analysis is an emerging area of Natural Language Processing. We can do sentiment analysis of text, emoticons, images, audio files, video files, emotions, non- language words etc. In this paper we reviewed different methods which are designed, developed and implemented to improve the performance in the field of sentiment analysis which is useful in decision making, review classification, opinion mining, summarization and optimization of data. It gives you improved results when more features get extracted from the data. It is also observed that most of the tasks are performed using Python libraries, R studio, Matlab and Java. As a future scope, there are chances to increase the accuracy of sentiment analysis. Lot of open ended questions like email management, fake user detection, bribed reviews, morph video identification need to be addressed. Emotion intensity detection is still an unfocussed area in sentiment analysis.

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