

Machine Learning Techniques for Sentiment Analysis: A Review

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ABSTRACT

With the advancement of informal community and Web 2.0, individuals not just devour content by downloading on the web yet contributing and producing new substance. Individuals turned out to be increasingly anxious to communicate and impart their insights on web viewing every day exercises just as nearby or worldwide issues. Because of the multiplication of web-based life, such as Facebook, Twitter, YouTube and others, supposition examination develops quickly. The number of recordings accessible on the web and somewhere else is consistently developing and with this the requirement for viable strategies to process the tremendous measure of multimodal data shared through this media. Right now, it centers around the investigation of different procedures are applied on different datasets. Additionally, condense the report of strategies most as often as possible utilized in AI for notion examination. In this paper, widely used machine learning methods of sentiment analysis are analyzed and summarized as various technologies applied on various authors' datasets.

Keywords: Sentiment Analysis, Social Media, Machine Learning Technologies.

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INTRODUCTION

Emotion recognition is the way toward determining the full of feeling condition of individuals. It assumes a significant job in emotional registering and human-PC communication (HCI) applications.¹ Estimation investigation or feeling mining is one of the incredible achievements of the most recent decade in Language Technologies. This field of study is identified with the examination of suppositions, assumptions, assessments, perspectives, and feelings of clients, which they express via web-based networking media and other online assets.⁴⁹ The ubiquity of internet-based life is expanding quickly in light of the fact that it is simply being used and easy to make and share pictures, video even from those clients who are in fact, uninformed of online networking. The quickly expanding prevalence of internet-based life locales, such as Facebook, Flickr and YouTube, is fundamental because of the convenience and user-friendliness of these frameworks for creating, collaborating, and sharing data (pictures, video) even from unknown users. For video sharing, YouTube is the most mainstream webpage on the Web.

Machine learning algorithms are often very helpful in conveying and prioritizing whether a document represents positive, neutral or negative emotions. Machine learning is grouped into two types of extensions such as unsupervised algorithms. The supervised algorithm uses a labeled dataset where each training document is written with positive

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emotions. While, unsupervised readings include raw data where the text is not written and positive emotions.³⁸

Sentiment analysis is used extensively at 3 categories or levels, namely sentence level, document level, and feature level. Documentary Depression aims to give the entire document or topic good or bad titles. Perceptual deduction considers the minimum of each sentence of a document while the presentation of the index section first identifies the various features of the corpus, and then for each text, the correlation is calculated subjectively to the findings.

Sentiment analysis becomes a sultry area in decision-making.³⁶ Sentiment analysis, concretely the automatic analysis of indicted reviews in terms of positive or negative valence, has been extensively studied in the last decennium. Sentiment Analysis provides various opportunities for the development of incipient use, mainly because of the astronomically immense magnification of already acquired

information in sources such as blogs and convivial networks [48]. Sentiment analysis requires collecting a lot of consumer reviews, visualizing if ideas are good or bad, and using them for commercial use. The analytical techniques are categorized into two main parts: position distribution and feature extraction described in the feature.⁹ Also, the visual transmission can be divided into two groups: the method determined by the company and the method described in the dictionary.

Understanding video-generated emotions applies to many programs, containing the delivery of customized data in the context of a user's change, video reference and suggestion, description or emotional interaction of disabled users. This posting's biggest challenge is the very long distance between low-quality signals and human understanding of video.²⁴

The paper continues as follows—section II basic definitions of various techniques of machine learning. In Section III, discuss about related work. Sections IV presents a summary report in tabular format of various techniques are applied through various authors and accuracy in percentage. At last, in Section V, the conclusions are discussed.

MACHINE LEARNING TECHNIQUES

Convolutional Neural Network(CNN)

Convolutional Neural Networks (CNN) is a particular sort of neural system which can function admirably with spatial information. CNNs are especially helpful in pictures for assignments, for example, order or division. Convolutional layers utilize just certain associations from past layer; explicitly, nearby neurons are associated with the neurons of the following layer. This strategy makes the layer acquire a comprehension of the general perspective on the information sources.

Recurrent Neural Network(RNN)

RNN is one of the profound methods that is utilized for opinion examination. It delivers the yield based on a past calculation by utilizing consecutive data. The conventional neural system already utilizes free information sources that are not fit for some assignment in Natural Language Processing.³⁰ For a model: word forecast in a provided sample sentence. RNN is an effective method for supposition examination Figure 1.

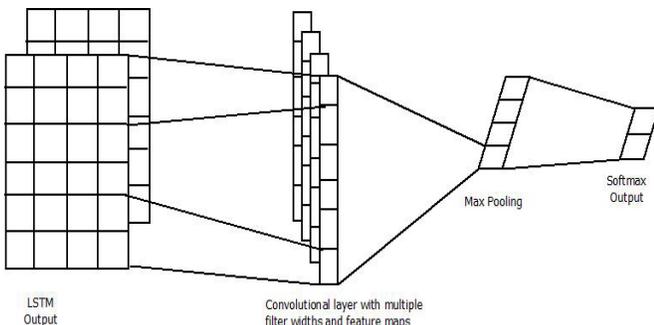


Figure 1: Structure of CNN³

The given equation shows the basic formula for RNN: $a_t = f(h_{t-1}, x_t)$. Where a_t a_t represents the output from previous node, activation function f is tanh function and x_t x_t denotes the input sequences ($x_0, x_1, x_2, x_3, \dots, x_t, x_0, x_1, x_2, x_3, \dots, x_t$) Figure 2.

A recurrent neural network has ameliorated the time intricacy. In RNN model, analysis is done word by word and it is time taking process.³⁰

Long Short-Term Memory (LSTM)

Recurrent neural network (RNN) is globally used in handling arrays of different lengths. The average RN is identical to many neural networks that are close to each other, the large amplification of the historical data presented in the long sequences will establish obvious growth and loss of data. LSTM is a modified network system programmed for RNNs. By linking the memory gates to the three control gates, LSTM preserves historical data in a long line, resulting in loss of historical data and air destruction resulting from poor RNN training³ Figure 3.

Bidirectional Long Short-Term Memory (BiLSTM)

BiLSTMs are proven supported, especially when installation context is required—supporting activities such as psychosocial transfers. Unnecessary LSTM information flows back and forth. In contrast, bi-directional information LSTM uses two hidden states that are backward but forward.²

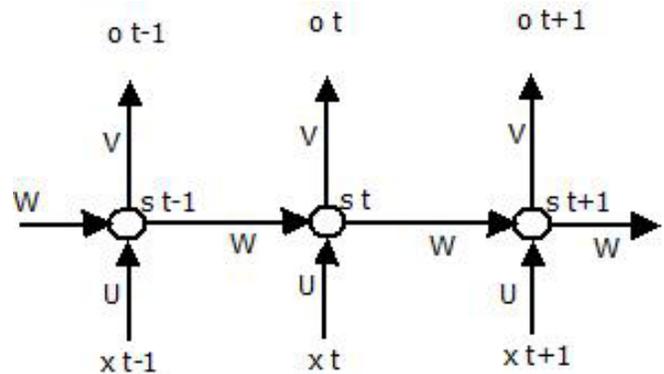


Figure 2: RNN Framework^[30]

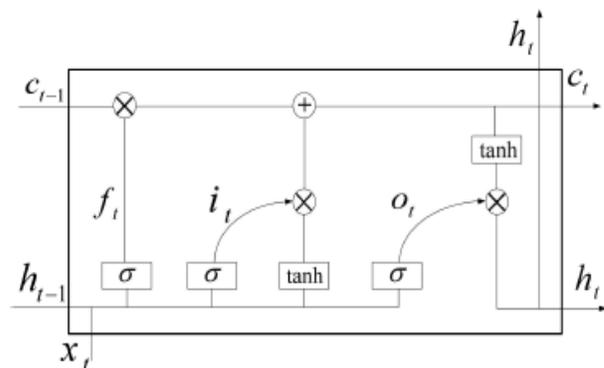


Figure 3: Structure of LSTM³

BiLSTMs thus understand the environment. BiLSTMs are built to load input information used on the network. Configuration or BiLSTM is displayed in Figure 4. By using 2-time codes, you can use input data from the previous and next of the current system frame.

NeuroSent

- NeuroSent is fully created in Java and in the guidelines of the Deeplearning4j library [50] and is developed in terms of two important sections:
- Word vectors Generation: raw, text-based text using the Stanford CoreNLP Toolkit is given as input to a 2-layer neural network using the skip-gram process for importing word vectors.⁵
- *Learning of Relations Model*: word vectors are utilized for training a recurrent neural network (RNN) (Gelenbe, 1993) with an output layer containing one node for each type of cognition fortified by the model. We decided to utilize RNN due to the indispensability of working with input information provided through a sequence of input instances (i.e. the injunctively authorized arrays of embeddings corresponding to each word of the text to analyze).

Word2Vec

The Word2Vec model is an advanced algorithm developed by Thomas Mikolov and his Google colleagues in 2013. the Word2Vec algorithm is available in two types: the Continuous Pack-of-Words (CPOW) model and the Skip-gram (SG) model. The continuous word pie model sets the required/target word, with the reference of the words, and the skip-gram model immerses the CBOW structure along with the prediction of a given word environment.

Senti Word Net

SentiWordNet is a lexical sentiment lexicon where every synset of the WordNet is related to goal, positive and negative

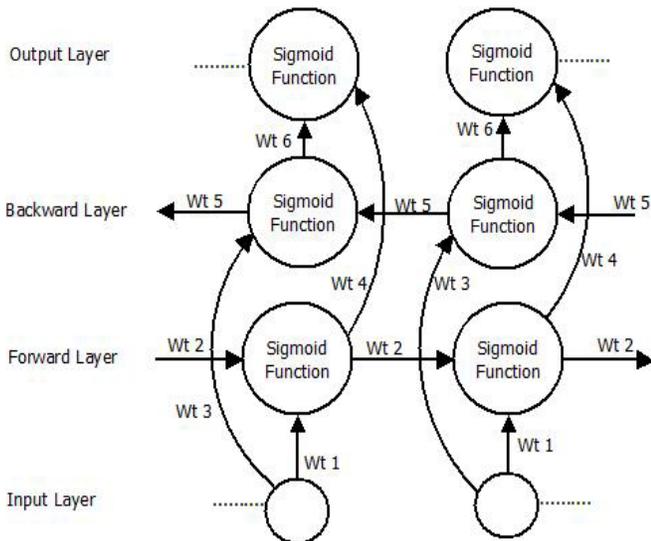


Figure 4: Bidirectional LSTM²

scores. It is regularly utilized in assumption investigation, which is an assortment of strategies to decide the book’s notion direction (either positive, negative or unbiased).

RELATED WORK

For precise discharge of sentiment, numerous researchers have made efforts to integrate the concepts of machine learning and deep learning into perpetual years. This section depicts inquiries quickly, knowing the user’s perceptions, emotions, and analysis of web content with reviews on a variety of topics, such as products that use motion pictures and deep learning techniques.

The authors have been presented the hybrid model for text classification that gives the better accuracy than traditional models. In this study, they merged 2 traditional neural network model named as CNN and LSTM. The experimental result showed the improvement in the accuracy of text classification. They evaluate 87.31% accuracy.² An efficient deep learning method has been suggested by authors for sentiment classification which calculates the accuracy 82.53% on Bengali text. In order to evaluate, they used two deep neural network models such as deep RNN with BiLSTM.⁴ Deep learning-based approaches achieved significant results in the field of text classification. The authors have been proposed an innovative approach for target-based sentiment analysis which reduces the training time of proposed model through regional LSTM.⁵

Deep learning models are frequently used in Natural Language Processing applications. An efficient approach has been proposed for multi-domain system that is based on word embedding. The tool named NeuroSent gives the accuracy 85.15% by using amazon web site dataset for multi-domain.⁶ Some of the deep learning models are based on text classification in NLP. An ensemble method was proposed for Vietnamese text for sentiment analysis by some researchers. In this model, they merged the traditional method with a deep learning algorithm. The suggested approach provides an accuracy 89.19% by using the vote rule.⁷ The author has been presented a paper on the deep learning approach for text classification.⁸

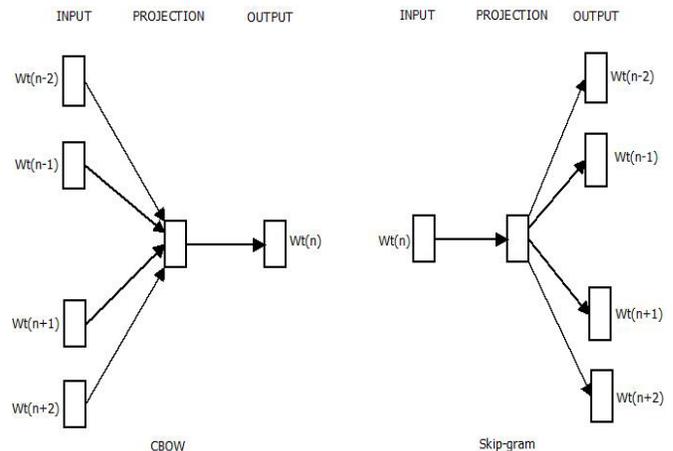


Figure 5: Word2Vec Architecture⁵¹



Table 1: Summary of methodologies and approaches

Reference No.	Author's Name and Year	Methodology	Proposed approach	Result in accuracy (%)
[1]	Shahla Nemati, Reza Rohani, Mohammad Ehsan Basiri, Moloud Abdar, Neil Y. Yen, Vladimir Makarenko [2019]	Emotion Recognition, Multimodal Fusion	CCA-SVM CFA-SVM MFA-SVM (DEAP dataset)	81 85 92
[2]	Abdullah Aziz Sharfuddin, Md. NafisTihami and Md. Saiful Islam [2018]	Bengali text, Deep learning, Sentiment Classification, RNN, LSTM, BiLSTM, Facebook, NLP	BiLSTM	85.67
[3]	Jiarui Zhang, YingxiangLi, JuanTian and Tongyan Li [2018]	Text Classification, Nature Language Processing, LSTM, Long Text Sequences, CNN	CNN-LSTM	87.31
[4]	Siyuan Chen, Chao Peng, LinsenCai and LanyingGuo [2018]	Deep learning, Sentiment analysis, Target-based sentiment analysis, Convolutional neural network, Long short termmemory network, Deep neural network model	CNN-RLSTM	94.35
[5]	Mauro Dragoni and Fondazione Bruno Kessler [2017]	Sentiment Analysis, Natural Language Processing, Neural Networks, Multi-domain Sentiment Analysis, Deep Learning	NeuroSent	84.60
[7]	Ali Alwehaibi and Kaushik Roy [2018]	sentiment analysis, natural language processing, deep learning, long-short term memory	AraFT	93.5
[9]	Min-Yuh Day and Yue-Da Lin [2017]	Deep Learning, Sentiment Analysis, Consumer Review, Recurrent Neural Network (RNN), Long Short Term Memory (LSTM)	Deep Learning with BiLSTM	94.00
[11]	Benwang Sun, Fang Tian and Li Liang [2018]	Deep Learning, Tibetan Microblog, Word vector, Sentiment Analysis	CNN-LSTM	86.21
[12]	Eissa M. Alshari, AzreenAzman, ShyamalaDoraisamy, Norwati Mustapha and MostafaAlkeshr [2018]	Sentiment analysis, Word2Vec, Word embeddings, SentiWordNet	SentiWordNet, Senti2vec	73.2, 85.4
[13]	Guang Yang, Haibo He, Fellow, IEEE, and Qian Chen [2019]	Natural language processing, sentiment analysis, deep learning, convolution neural network, emoticons.	ECNN	72.55
[15]	JingjingCai, Jianping Li, Wei Li And Ji Wang [2018]	Deep learning model, Text classification, Natural Language Processing, CNN, RNN	TextRNN+ Attention	84.56 (precision)
[16]	Arman S. Zharmagambetov and Alexandr A. Pak [2015]	NLP, sentiment analysis, deep learning, machine learning, text classification	Deep Learning	89.8
[18]	Oscar B. Deho, William A. Agangiba, Felix L. Aryeh and Jeffery A. Ansah [2018]	Word embedding, Word2Vec, Machine Learning, Bag-of-words.	Word2Vec	81

[24]	Claudio Baecchi, Tiberio Uricchio, Marco Bertini and Alberto Del Bimbo [2017]	Sentiment analysis, video analysis, affect recognition (1. LIRIS-ACCEDE & 2. MEDIAEVAL-2015) dataset	VGG-FC7 + VGG-FC8 + Sent-FC7 + Sent-FC8 + Faces (applied on both dataset)	Valence Accuracy 1. 45.82 2. 45.31 Arousal Accuracy 1. 53.11 2. 55.98
[30]	Alpna Patel and Arvind Kumar Tiwari [2019]	Sentiment Analysis, Deep Learning, Sentiment Classification, Machine Learning	RNN	87.42
[32]	Abubakr H. Ombabi, OnsaLazzez, WaelOuarda, Adel M. Alimi [2017]	Sentiment Analysis, Word2Vec, CNN	CBOV	96
[33]	XingtongGe and XiaofangJin, Bo Miao, ChenmingLiu and XinyiWu [2018]	Sentiment analysis, machine learning, Word2vec, Lexicon	Random Forest Classifier	94
[35]	Ravi Kumar, Vadlamani Ravi, SrirangarajSetlur and VenuGoovindaraju [2018]	Citation sentiment Analysis, Deep Learning, Machine Learning	wvCNN-non-static	44.4 (Mac F1)

A novel approach has been proposed for IMDB movie review sentiment analysis by using the Deep CNN-LSTM model, which gives the accuracy 89%.⁹ Some authors give a survey on different deep learning models for sentiment analysis. An analytical study is given by using deep learning models and classifiers.¹⁰ Researchers have been suggested a deep learning approach for sentiment analysis.¹¹ The ensemble approach has been performed better than traditional models in the area of text classification. In this study, a deep learning approach has been proposed for performing sentiment analysis. They used Long Short Term Memory, Naïve Bayes, and Support Vector Machine for sentiment analysis by using reviews on Google Play in Chinese.¹²

The authors have been proposed a model named SentiWordNet that is depends on Word2Vec to perform sentiment analysis.¹³ A novel approach proposed by researchers named ECNN that is to identify opinion, polarity and emotions in microblogs.¹⁴ For performing sentiment analysis, the authors have been presented the model related to text classification. They used word embedding at word level and sentence level by using skim gram model.¹⁵ The authors have proposed a text sentiment analysis method based on CNN and Support Vector Machine.¹⁶ The authors have been proposed an efficient method to perform sentiment analysis on the IMDB review dataset. They found that the deep learning model RNN is effective in terms of words semantic and evaluates the accuracy of 89.8%.¹⁷

The author has built a model based on heterogeneous features such as machine learning-based and Lexicon based features to perform sentiment analysis on movie review dataset [18]. The authors have been used word embedding for sentiment analysis. An efficient approach has been proposed

for sentiment analysis by using word embedding.¹⁹ Some of the authors have been presented an overview of sentiment analysis. A joint framework has been proposed for sentence classification that is based on CNN and RNN. The suggested framework provides the accuracy of 93.3% on movie review dataset, 48.8% fine-grained, and 89.2% binary accuracy, respectively.²³

The authors have been proposed a deep learning approach for sentiment analysis. Patel Alpna and Tiwari AK³⁴ is calculated the accuracy of 87.42% by using RNN. The authors have been presented as a novel method to extract features and textual modalities by using deep CNN.³⁵ The authors have been proposed a framework for user's interests classification that is based CNN and Word2Vec. The proposed framework is based on deep learning, and they used CBOV as a feature extraction algorithm and SVM for classification that give the accuracy 96% on IMDB movie review dataset.³⁶

Changliang Li *et al.*³⁷ builds the Chinese Sentiment Treebank over social data and further introduces an approach named Recursive Neural deep model for the analysis process. Kumar Ravi *et al.*³⁸ performed sentiment analysis on article citation sentences, and they have been proposed an ensemble method for deep learning.

CONCLUSION

Sentiment analysis has emerged as a very significant tool for the commercial purposes. Therefore, with the help of sentiment analyzers, there are various ways to understand the activities and choices of users. This analysis uses different methods and algorithms of Natural Language Processing (NLP) This study provides a comprehensive review of various datasets' research work using different machine



learning techniques for sentiment analysis. For this study, we have reviewed and identify many techniques to be used in machine learning for sentiment analysis. The Summary and the report of machine learning techniques had been presented.

In future work, we will try for dataset collection and apply machine learning techniques on datasets to identify the polarity of videos using URLs. First, the feature extraction will be done from each frame in the video. Boundaries are detected by using the boundary detection algorithm and then reduce the representation using machine-learning algorithms.

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