**Machine Learning vs Deep Learning Approach for Sentiment Analysis on Twitter Data**

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**ABSTRACT-** Sentiment Analysis is a process of categorizing whether the text is positive, negative, or neutral. Not only this but it also includes the emotions like happiness, sadness, anger, fear, and surprise. Sentiment analysis can be used in various fields, some well know fields including online shopping. When customers buy product, they give their feedback and it is very crucial for an e-commerce company and product manufacturer to review and analyze the customers feedback. Sentiment analysis can solve real-time issues and it is a crucial task in Natural Language Processing (NLP). We can use traditional Machine Learning algorithms, such as Support Vector Machine (SVM), Tree based technique or Naïve Bayes have been widely used for sentiment analysis. With the advent of deep learning (DL) techniques, like CNN, RNN or state of the art methods changed this field to capture the more complex pattern in data. This paper presents the comparative study of sentiment analysis using ML and DL techniques. We used ML and DL algorithms against Twitter Sentiment Analysis data and compare the algorithms based on accuracy, computational efficiency, and ability to adopt the complex pattern in large dataset. This paper provides insights into the trade-off between ML and DL approach for Sentiment Analysis, further guiding for researchers and practitioner in choosing the appropriate approach for their specific tasks.

**Key Words:** Sentiment Analysis, Machine Learning, Deep Learning RNN, LSTM, GRU

1. INRODUCTION

As, the whole world connect to internet, data is everywhere and the famous quote “Data is the new Oil” is relevant to current world. This data includes customer feedback, review on the product they buy, people’s opinion on various topics on different social media platform. For the e-commerce website like Amazon, Flipkart, Walmart it is crucial for them to analyze the customers feedback, review of the product to increase the product sells. Also, the manufacturer can improve and addressing the customers concerns, to enhance the customers experience and satisfaction by analyzing the sentiment of customers reviews and feedback. Sentiment analysis can help business to monitor their reputation by tracking the comments, social media reviews. By understanding the users review product development can improve their products. Companies like Twitter, Facebook, Instagram can analyze people’s opinion on current trending topics like elections, wars keep the platform safe and make sure that platform stays neutral for all users and it do not get bias into specific direction. This companies also used sentiment analysis to monitor the tweet, post to make sure that it is appropriate and follows all the community guidelines, and if someone going against the guidelines, they remove their content from the platform. We can use Machine Learning and Deep Learning algorithm to classify the sentiment. However, which technique is suitable for problem statement it depends on the data size and ability to adopt to new context.

There are the few observations on which the system architecture is proposed.

1. LITERATURE REVIEW
2. **Lexical or Rule-Based Approach:**

In “Twitter Sentiment Analysis Using Lexical or Rule Based Approach: A Case Study” [1] Sheresh Zahoor an Rajesh Rohila use Lexical or Rule Based (unsupervised technique) for twitter sentiment analysis. Using twitter API they create 4 different datasets. 1. Haryana Assembly Polls 2. ML Khattar 3. The sky is pink (movie) 4. United Nations General Assembly (UNGA). Step they follow to collect the data and analyze the sentiments are:

1. Data Collection
2. Data pre-processing
3. Part of Speech tagging (POS)
4. Sentiment analysis using in-built dictionary
5. Data Collection:

To collect the data from twitter they user twitter API and collect the tweet and save it in CSV format. CSV file contains the date, text, retweet, hashtag, followers.

1. Data Pre-Processing:

To prepare data for sentiment analysis they perform various operations on data including tokenization or Bag-of-words, N-gram Extraction, Stemming and Lemmatization, and StopWords removal.

1. Part-of-Speech (POS):

Process of automatically tagging each word by their grammatical feature such as Noun, Pronoun, verb, adverb etc.

1. Model Evaluation:

They used TextBlob and VADER built-in libraries available in python. TextBlob is an open-source NLTK based library whereas VADER (Valence Aware Dictionary and sentiment Reasoner) is used for lexicon-based sentiment analysis. The result they conclude is:

Case 1: Haryana Assembly Polls

Case 2: ML Khattar

Case 3: The sky is pink

Case 4: United Nations General Assembly

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sentiment | Case 1 | | Case 2 | |
| Text Blob | VADER | Text Blob | VADER |
| Positive | 29.7% | 44% | 58.5% | 58.5% |
| Negative | 12.0% | 17.6% | 9.6% | 9.6% |
| Neutral | 58.3% | 38.5% | 32% | 20.5% |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sentiment | Case 3 | | Case 4 | |
| Text Blob | VADER | Text Blob | VADER |
| Positive | 64.1% | 62.8% | 36.2% | 33.4% |
| Negative | 12.1% | 12.7% | 12.6% | 40.1% |
| Neutral | 23.8% | 24.5% | 251.2% | 26.5% |

The conclusion of this case study they found that the result obtained from unsupervised technique are not accurate and subject to change.

1. **Deep Learning Approach:**

Vasily D. Derbentsev and Vitalii S. Bezkorovainyi et al. publish “A comparative study of deep learning models for sentiment analysis of social media texts” [2] paper. The author of this paper presents a comparative study of deep learning model for sentiment analysis of social media text. They used Deep Neural Network (DNN), Convolutional Neural Network (CNN) and Long-Short Term Memory (LSTM) architecture and Logistic Regression classifier as a baseline. The choose 2 datasets for their study one is IMDB Movie Reviews and other is Twitter Sentiment 140.

For Feature Extraction they follow Bag of Words (BOW), N-grams, TF-IDF, word embedding

1. Pre-Processing and word embeddings:

For text-preprocessing task they used NLKT library and this task includes removing punctuations, markup tags, HTML and Tweet address, removing stopwords and converting all word into lower case word.

1. DNN models design and hyperparameters settings:
2. Used pre-trained GloVe embeddings of size 100 in first layer (embedding layer)
3. First model CNN with three convolutional layers with different kernel size and used Maxpooling layers between them and then flatten and Dense layer.
4. In second approach they combine the CNN+LSTM
5. Third, CNN + BiLSTM (forward and Backward LSTM)
6. To obstruct overfitting Dropout layers are used
7. Evaluation:

IMDB Dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Models | LR | CNN | CNN-LSTM | CNN-BiLSTM |
| Precision | 86.62% | 90.04% | 90.90% | 83.08% |
| Recall | 85.54% | 90.31% | 84.84% | 93.25% |
| F1-Score | 86.08% | 90.18% | 87.76% | 87.87% |
| Accuracy | 85.90% | 90.09% | 88.08% | 87.03% |

Twitter-140 dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Models | LR | CNN | CNN-LSTM | CNN-BiLSTM |
| Precision | 71.61% | 76.17% | 78.98% | 79.54% |
| Recall | 74.63% | 79.47% | 77.47% | 84.41% |
| F1-Score | 73.09% | 77.78% | 78.23% | 81.91% |
| Accuracy | 79.54% | 77.24% | 78.37% | 82.10% |

The experiment showed that LR (baseline) achieved 85.9% (74.23%), CNN achieved 90.09% (77.24%), CNN-LSTM reached 88.01% (78.36%), and BiLSTM-CNN attained 87.03% (82.10%).

1. **Machine Learning Algorithms:**

**REFRENCES**

[1]Sheresh Zahoor, Rajesh Rohilla “Twitter Sentiment Analysis Using Lexical or Rule Based Approach: A Case Study”

[2] ABC