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

**Swapnil sonawane Sneha Thakur**

[Swapnils0098@gmail.com](mailto:Swapnils0098@gmail.com) [thakursneha578@gmail.com](mailto:thakursneha578@gmail.com)

**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-known fields including online shopping. When customers buy products, they give their feedback, and an e-commerce company and product manufacturer must review and analyze the customer's feedback. Sentiment analysis can solve real-time issues and 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. 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 compared the algorithms based on accuracy, computational efficiency, and ability to adopt complex patterns in large datasets. This paper provides insights into the trade-off between ML and DL approaches for Sentiment Analysis, further guiding researchers and practitioners in choosing the appropriate approach for their specific tasks.

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

1. INTRODUCTION

As the whole world connects to the internet, data is everywhere and the famous quote “Data is the new Oil” is relevant to the current world. This data includes customer feedback, reviews on the products they buy, and people’s opinions on various topics on different social media platforms. For e-commerce websites like Amazon, Flipkart, and Walmart they must analyze the customer's feedback, and review the product to increase the product sales. Also, the manufacturer can improve and address the customer's concerns, to enhance the customer's experience and satisfaction by analyzing the sentiment of customers' reviews and feedback. Sentiment analysis can help business monitor their reputation by tracking the comments, and social media reviews. Understanding the users review product development can improve their products. Companies like Twitter, Facebook, and Instagram can analyze people’s opinions on current trending topics like elections, and wars to keep the platform safe and make sure that the platform stays neutral for all users and does not get biased in a specific direction. These companies also used sentiment analysis to monitor the tweets and posts to make sure that it is appropriate and follow all the community guidelines, and if someone goes against the guidelines, they remove their content from the platform. We can use Machine Learning and Deep Learning algorithms to classify the sentiment. However, which technique is suitable for problem statements depends on the data size and ability to adapt to new contexts.

There are a 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 and 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). The steps 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 an in-built dictionary
5. Data Collection:

To collect the data from Twitter they use Twitter API and collect the tweet and save it in CSV format. CSV file contains the date, text, retweet, hashtag, and 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 found that the results obtained from unsupervised techniques are not accurate and subject to change.

1. **Deep Learning Approach:**

Vasily D. Derbentsev and Vitalii S. Bezkorovainyi et al. published “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 a deep learning model for sentiment analysis of social media text. They used Deep Neural Network (DNN), Convolutional Neural Network (CNN) Long-Short Term Memory (LSTM) architecture, and Logistic Regression classifier as a baseline. They chose 2 datasets for their study one is IMDB Movie Reviews and the 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 the text-preprocessing task, they used the NLKT library and this task includes removing punctuations, markup tags, HTML and Tweet addresses, removing stopwords, and converting all words into lowercase words.

1. DNN models design and hyperparameters settings:
2. Used pre-trained GloVe embeddings of size 100 in the first layer (embedding layer)
3. First model CNN with three convolutional layers with different kernel sizes and used Maxpooling layers between them and then flatten and Dense layer.
4. In the 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:**

**REFERENCES**

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

[2] ABC