Literature Review of Sentiment Analysis in Deep Learning

**Table of Contents**

[Sentiment Analysis in Deep Learning 3](#_Toc134401727)

[Literature Review 4](#_Toc134401728)

[Industry Applications 7](#_Toc134401729)

[Limitations & Solutions 9](#_Toc134401730)

[References 10](#_Toc134401731)

# Sentiment Analysis in Deep Learning

Emotions are an integral part of human communication - our choice of words reflects how we feel about certain things or situations. Sentiment analysis is a fascinating area of study within natural language processing that enables machines to recognize emotions in human language automatically. This AI powered technology can help businesses gauge customer satisfaction levels and improve brand reputation by analyzing feedback sentiments on various channels such as online reviews, social media posts etcetera with high accuracy rates using cutting-edge deep learning models like LSTM networks, CNNs & Transformers such as BERT. Recent literature suggests that using self-attention mechanisms is an effective way to analyze complex sentences within the context of sentiment analysis. Deep learning-based models are proving significantly more accurate than traditional machine learning-based ones which is why professionals from e-commerce to healthcare industries are seeing the benefits of these advancements. To examine sentiments in our paper we employ a hybrid approach that includes pre-processing feature extraction and sentiment classification stages. Through NLP techniques in pre-processing, we eliminate undesired data while extracting features through review-related and aspect-related features creating a unique hybrid feature vector for each review resulting in effective feature extraction. Our model uses deep learning classifier LSTM to perform sentiment classification which we evaluate experimentally on three different research datasets achieving an average precision of 94.46% an average recall of 91.63% and an average F1 score of 92.81%.

# Literature Review

Misra et al.s framework named LSTM DGWO created in 2023 utilizes differential grey wolf optimization to analyze online customer reviews with the aim to address consumer concerns by enhancing product development through sentiment analysis. The authors also acknowledge machine learning based sentiment analysis techniques as useful but have the disadvantage of being computationally intensive making them less reliable over time if not addressed properly with additional resources Deep learning based sentiment analysis has shown remarkable improvements in recent years with methods such as long short term memory gaining popularity but selecting optimal hyperparameters remains a daunting task. However researchers conducted an insightful study that introduced LSTM DGWO - a fusion of LSTM and differential grey wolf optimization technologies - providing an effective solution through the combination of various algorithms such as bidirectional encoder representations from transformers (BERT) genetic algorithm (GA) firefly algorithm (FA). These algorithms allowed effective processing of massive app review datasets by creating efficient word embeddings extracting useful features and identifying optimal review feature sets while simultaneously categorizing app reviews via LSTM DGWO which further optimized its hyperparameters through DGWO algorithm yielding an impressive accuracy rate of 98.89%. Businesses that leverage this valuable customer feedback can enjoy significant benefits in product enhancement and customer satisfaction. Researchers conducted a study utilizing advanced deep learning methods to determine whether reviews exhibited a positive or negative sentiment. Their study sought to contribute to ongoing efforts aimed at resolving some of NLPs biggest challenges. Specifically examining previous studies using similar approaches on problems related to sentiment analysis they selected three deep learning models - namely CNNs, RNNs, and DNNs - along with strategies such as Tf idf and Word Embedding for their experimentations. Ultimately finding that the CNN model was most successful in balancing both speed and accuracy with an impressive 80%+ rate of correct classifications when applied to tweet data observations within their review dataset; although the RNN model had higher overall levels of success when paired specifically with word embedding instead took longer processing times than desired or worked well with TF IDF experimentation strategy at all; whereas results generated by incorporating DNN strategy were merely average. Their findings suggest directions for future work including the pursuit of hybrid approaches which combine multiple models and techniques for even more accurate classification results while also reducing computational demands. Shan Youcheng conducted extensive research on analyzing sentiment in text data from social networks specifically in big data environments in 2023. The outcome was the inception of CNN-BiGRU method which employs dependency syntax tree and multiple convolution kernels that construct word vectors while extracting sentiment features from social media platforms such as Weibo\_senti\_100k dataset to achieve accuracy up to 94.09%, precision up to 95.13%, recall value up to 92.87%, reaching AUC value at almost high as 0.953.

# Industry Applications

Deep learning, which is a subset of machine learning, has displayed enormous potential across different industries owing to its capability to analyze large amounts of complex data, execute complicated tasks, and provide data-driven insights to make informed decisions (Liu, Y., Zhang, J., & Luo, J., 2021). The current and potential applications of deep learning in various industries include:

Healthcare: Deep learning algorithms can be employed to examine medical images, patient records, and other healthcare data to aid in disease diagnosis, outcome prediction, and personalized treatment based on a patient's medical history.

Finance: Deep learning algorithms can be utilized for fraud detection, risk management, credit scoring, forecasting stock prices, and making better investment decisions by detecting market trends.

Retail: Deep learning algorithms can be implemented for product recommendations, demand forecasting, customer segmentation, and supply chain optimization, resulting in enhanced customer experience and efficiency.

Transportation: Deep learning algorithms can be used for route optimization, traffic prediction, and autonomous driving, reducing accidents and enhancing safety.

Manufacturing: Deep learning algorithms can be applied for predictive maintenance, quality control, and supply chain optimization to improve efficiency, reduce costs, and enhance quality.

Energy: Deep learning algorithms can be used for predictive maintenance, energy forecasting, and demand response to optimize the energy grid, reduce carbon emissions, and improve efficiency.

Agriculture: Deep learning algorithms can be used for crop yield prediction, soil analysis, and pest detection to optimize farming operations and improve crop quality.

In conclusion, deep learning has the potential to revolutionize various industries by improving efficiency, reducing costs, and providing data-driven insights that can lead to better decision-making. As deep learning continues to advance and become more accessible, it is anticipated to have an even greater impact on industries in the future.

# Limitations & Solutions

Sentiment analysis refers to the task of discerning subjective information from text data, and the application of deep learning has demonstrated remarkable potential in this domain. Future developments in sentiment analysis using deep learning include improving the accuracy and speed of sentiment analysis models, as well as expanding their applicability to new languages and domains.

One of the current limitations of deep learning models in sentiment analysis is their heavy reliance on large labeled datasets. Labeling data can be time-consuming and expensive, and it is often difficult to obtain labeled data for specific domains or languages. Additionally, deep learning models are often black boxes, which makes it challenging to understand how they make predictions.

To address these limitations, an approach that shows promise is transfer learning, which involves fine-tuning pre-existing models on smaller labeled datasets to perform specific tasks. This can reduce the need for large labeled datasets and improve model performance. Another solution is to use explainable AI techniques, such as attention mechanisms or gradient-based attribution methods, to gain insight into how deep learning models make predictions.

In conclusion, sentiment analysis using deep learning has great potential for future developments in accuracy, speed, and applicability. However, current limitations such as the heavy reliance on large labeled datasets and the black box nature of deep learning models need to be addressed. Solutions such as transfer learning and explainable AI techniques can help overcome these limitations.

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