# AN ANALYSIS OF DIFFERENT SEQUENTIAL PATTERN-BASED SENTIMENTAL ANALYSIS TECHNIQUES USING PRODUCT REVIEWS

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**ABSTRACT**

Sentiment analysis is the process of finding opinions or feelings about a specific topic in written text. With the rise of social media, more people are sharing their thoughts online. This has made sentiment analysis very important because the opinions found in the text can help with things like recommendation systems, understanding social networks, predicting market trends, and political discussions. A key part of this analysis is aspectterm extraction, especially from customer reviews. This means recognizing specific details or features mentioned in reviews, which can be quite challenging. This survey examines 25 research papers focused on sequential pattern-based sentiment analysis. It begins by outlining a common framework for sequential pattern-based sentiment analysis and categorizes it into five primary approaches: Attention mechanism-based, Transformer-based, Statistical, Machine Learning (ML)-based, Deep Learning (DL)-based, and sequential pattern-based approaches. The analysis of the existing techniques highlights research gaps that can guide future innovations in the field. This study reviews the methodologies employed in the 25 articles and also analyzes publication year, research approaches and performance metrics of various methodologies. The evaluations how that DL-based approaches are the most frequently employed methods. Moreover, Python emerges as a prevalent tool, while the most commonly utilized database is Amazon review database. Additionally, accuracy is the majorly used analytical metric, often reported with high values.

**Keywords:** Product review, Sentiment analysis, sequential pattern-based Sentiment analysis, Machine learning Deep Learning.

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## I. INTRODUCTION

The count of internet users and e-commerce sales is continually developing and the rapid growth in e-commerce has led to an enhancing number of people purchasing products online. While e-commerce holds tremendous potential, several demands and limitations affect its growth. One important drawback of online shopping is that consumers cannot physically touch, try on, or inspect the products. As a result, it can be demanding for consumers to feel confident that the product they are attracted in is the right choice for them. The primary objective is gathering product reviews from consumers who have purchased the product. This detail serves as the foundation for developing a user-friendly platform that allows consumers, e-commerce owners, and product manufacturers to effortlessly access and evaluate reviews. To enhance this process, sentiment analysis is implemented to categorize every review in accordance with the sentiment expressed in the customer's feedback, labeling them as positive, negative, or neutral. Additionally, a summary of the product reviews is generated on the basis of specific product features. Sentiment refers to an attitude, thought, or judgment that arises from emotions. Sentiment analysis is also termed as opinion mining, examines an individual's sentiments regarding specific entities. Sentiment Analysis is a crucial Natural Language Processing (NLP) technique employed to determine whether the gathered data is positive, negative, or neutral. Neural Networks to interpret and grasp the intricacies of human language. A widely used method involves Recurrent Neural Networks (RNNs), specifically Long Short-Term Memory (LSTM) networks, which are developed to manage sequential data as well as retain contextual information over extended text sequences. Thus, DL approaches is suitable for sentiment analysis utilizing product reviews.

The approaches utilized for Sequential pattern-based sentimental analysis utilizing product reviews are categorized into five main types: DL, ML, transformer-based

approaches, attention mechanism-based techniques and sequential pattern-based approach. This review examines the utilized tools, categorization of approaches, databases utilized, and the metrics applied.

## II. LITERATURE SURVEY

This study provides an overview of various techniques for Sequential pattern-based sentimental analysis, including DL, ML, transformer-based, attention mechanism and sequential pattern-based techniques. Additionally, the limitations of these methods are discussed, which may inspire researchers to develop new and innovative Sequential pattern-based sentimental analysis models.

**2.1 Deep Learning Based Approach -** for sentiment analysis in product reviews, mainly focused on classifying expressed sentiments. For addressing the problem of imbalanced distributions among positive and negative samples in social network data, this technique adopted a resampling approach that adjusted the database by amplifying samples from the minority class while diminishing samples from the majority class. This technique was evaluated utilizing Amazon data across four product categories. Moreover, this technique was useful to understand context-specific language and sentiment nuances, even though it suffered due to difficulties in integration, mainly when aligning the resultant from several sources.Every category performed review analysis utilizing DLMNN, which categorizes the reviews into three sentiments, negative, positive, and neutral. Moreover, IANFIS was utilized as a weighting factor for the classification process to forecast the performance of the product in the future. Furthermore, this model was able to capture intricate patterns in larger databases and allowed for exact sentiment analysis.[1]

**2.2 Machine Learning -** ML is a subfield of computer science focused on developing algorithms and utilizing data to enable artificial intelligence to mimic human understanding, while continuously improving its accuracy. MLapproach for sentiment analysis utilizing product reviews.Initially, an evaluation of the Amazon Reviews database was carried out that focused on sentiment classification through different ML approaches. Then, the reviews were converted into vector representations utilizing diverse approaches, such as Bag-of-Words, TF-IDF, and GloVe. Moreover, different ML algorithms were trained and these techniques were evaluated on basis of different measures for attaining optimal outcomes. Additionally, this approach monitored sentiment around competitor products to recognize opportunities and weaknesses in the market. But, the sheer volume of reviews might create problems in processing and evaluating data, particularly with noise from irrelevant or duplicate reviews.[2]

**2.3 Transformer Based Approach:** This method utilizes a DL model that utilizes transformers, originally designed for image recognition tasks. It segments an image into patches and processes these patches utilizing transformers to gather the necessary information for classification.This technique utilized the pre-trained BERT model and the Text-to-Text Transfer Transformer (T5) model to predict customer emotions precisely related to eco-friendly products. Both techniques were trained on the incorporation of synthetically created databases to extract suitable features from customer reviews. Thereafter, this technique conducted sentiment analysis to categorize the reviews into positive, negative, and neutral sentiments on basis of diverse aspects. Additionally, it had the ability to grasp the dependencies and semantics in reviews, thus enhancing sentiment detection.[3]

**2.4 Sequential Pattern-Based Approach:** This technique is mainly used in data mining and ML to discover patterns in sequential or time-series data. It focuses on recognizing frequent ordered subsequences within a database, which can offer insights into temporal behavior and relationships. This technique is particularly useful in various applications like customer behavior analysis and web usage mining. This approach was helpful in assessing the influence of sequential pattern-based rules on the aspect extraction phase. Consequently, it was useful for extracting a limited count of patterns. Moreover, this approach utilized straightforward

rules to derive explicit aspects, resulting in improved outcomes. Additionally, this technique could minimize false positives and focus on the most relevant targets. [4]

## III. ASSESSMENT BASED APPROACH

This section of the research article examines various techniques for sequential pattern-based sentiment analysis, as depicted in Figure 1. It is identified that 56% of the examined papers utilized DL techniques, while 16% utilized ML-based techniques. In addition, 12% of the studies introduced sequential pattern-based techniques. Moreover, 4% of papers utilized transformer-based approaches and 4% of papers are utilized by other techniques. Among the analyzed techniques, DL modules emerged as the most frequently employed approach for sequential pattern-based sentiment analysis.

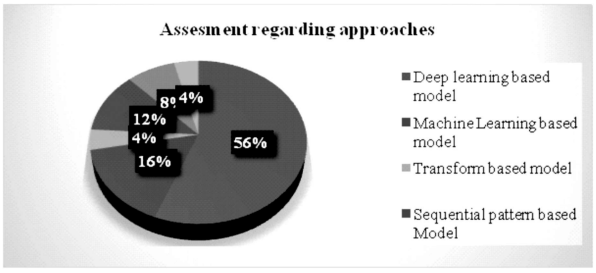


Figure 1. Evaluation with respect to modules for sequential pattern-based sentiment analysis

**3.1 Assessment Based on Tool Set -** This part outlines the tools employed by classical approaches for sequential pattern-based sentiment analysis using product reviews. As explained in Figure 2, the tools involved in this research include the Gensim1, google, java, jupyter notebook, keras, python, tensor flow, MATLAB and Stanford parser. Based on the information presented in Figure 2, it is evident that python is the most frequently utilized tool for sequential pattern-based sentiment analysis.

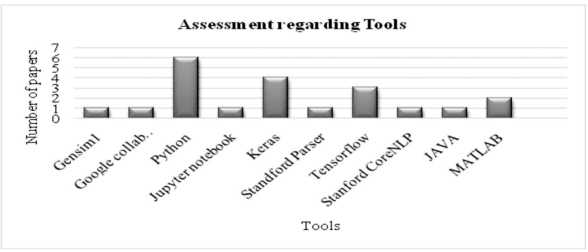


Figure 2.Evaluation with respect to Tools

**3.2 Estimation with respect to utilized databases -** This part evaluates the assessment based on the databases employed by classical methodologies. As represented in Figure 3, several datasets are employed and these include amazon review database, product review Database, twitter datasets, combined dataset, facebook database, the sentiment analysis dataset, iphone reviews, synthetic data are the databases employed for sequential pattern-based sentiment analysis. This assessment reveals that the majority of utilized database is amazon review database. Figure 3 illustrates assessment in regards to database.

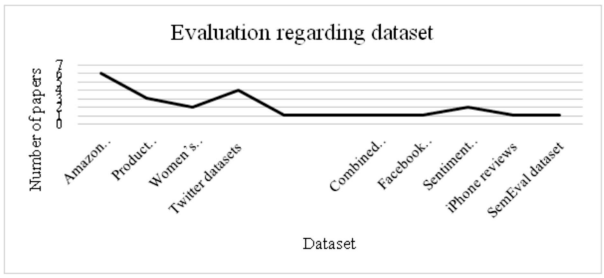


Figure 3. Assessment with respect to database

**3.3 Assessment on basis of evaluation metrics -** This section provides an overview using various assessment metrics. The evaluation metrics employed for sequential pattern-based sentiment analysis include accuracy, cross entropy loss, precision, RMSE, F1-score, MAE, Pearson correlation coefficient and recall. As shown in Table 1, 17 papers utilized accuracy, 14 papers used precision, and 14 papers employed recall are the mainly utilized analytic measure. Table 2 implies assessment regarding evaluation measures.

Table 1. Assessment regarding evaluation measures

| Evaluation Metrics | Number of papers |
|---|---|
| Accuracy | [3]. [5], [6], [7], [8], [9], [11], [12], [13], [15], [16], [19], [20], [21], [22], [23], [24], [25] |
| Precision | [1], [2], [3], [4], [5], [9], [10], [12], [13],[14], [15], [16],[17], [23] |
| Recall | [1], [2], [3], [4], [5], [9], [10], [12], [13],[14], [15], [16],[17], [23] |
| F1-score | [1], [2], [3], [4], [5], [9], [10], [12], [13], [15], [16],[17], [23] |
| Cross entropy loss | [5] |
| Mean absolute error (MAE) | [8], [18] |
| Pearson Correlation Coefficient | [18] |
| Root Mean Square error (RMSE) | [8] |

**3.3.1 Assessment regarding year of publication -** This part implies an estimation of the sequential pattern-based sentiment analysis in relation to the year of publication. An analysis of the publication years is expounded in Table 2. This assessment reveals that the majority of research papers are published in 2023.

Table 2. Assessment utilizing publication year

| Publication years | Number of papers |
|---|---|
| 2016 | 2 |
| 2018 | 1 |
| 2019 | 1 |
| 2020 | 3 |
| 2021 | 5 |
| 2022 | 3 |
| 2023 | 6 |
| 2024 | 4 |

**3.4 Estimation in terms of evaluation metrics -** An evaluation based upon metrics value is illustrated as beneath. Here, an assessment regarding accuracy is expressed below.

**3.4.1. Assessment regarding accuracy -** The estimation concerning accuracy is presented in Table 3. This table categorizes accuracy values into several ranges: 60-65%, 80-85%, 85-90%, 90-95% and 95-100%. It is evident from the table that the papers [7], [21] [22] [23] and [24] achieved high accuracy values within 85-90 % range. Moreover, the papers [11] reported accuracy values between 90-95 %, while the research papers [12], [15], and [19] obtained accuracy values ranging from 80-85%. Additionally, the paper [8] attained accuracy in range of 60-65%.

Table 3. An assessment regarding accuracy

| Accuracy range % | Number of papers |
|---|---|
| 60-65% | [8] |
| 80-85% | [12],[15],[19] |
| 85-90% | [7],[21],[22],[23],[24] |
| 90-95% | [11] |
| 95-100% | [3],[5],[20] |

## IV. CONCLUSION

Product reviews are important for offering valuable benefits to both consumers and producers. Nevertheless, evaluating the large volumes of data from comments, and views can be quite demanding for business intelligence efforts. By utilizing sentiment analysis on this content, both consumers and producers can gain a clear understanding of market trends, allowing them to make well-informed decisions. This survey examines 25 research papers focused on sequential pattern-based sentiment analysis. Initially a common framework for sequential pattern-based sentiment analysis is categorized into five primary approaches: Attention mechanism-based, Transformer-based, ML-based, DL-based, and sequential pattern-based approaches. This study reviews the methodologies employed in the 25 articles, considering factors such as publication year, research approaches and performance metrics. The findings implies that DL-based approaches are the most frequently utilized methods across numerous papers. Furthermore, python emerges as a prevalent tool, while the most commonly utilized database is amazon review database. In addition, accuracy is identified as the primary analytical metric, often reported with high values. Future work will concentrate on automatically identifying and analyzing specific aspects of products to provide granular sentiment insights.

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