

# An Overview of Textual Sentiment Analysis and Emotion Recognition

Pallavi Suryavanshi, Dr Sunil Patil

Department of Computer Science and Application Rkdf Bhopal

**Abstract-** Opinion mining, another name for sentiment analysis, is a crucial task in natural language processing (NLP) that enables the extraction of subjective information from text. Sentiment analysis can use machine learning algorithms to classify opinions in text into three categories: neutral, negative, and positive. In the Internet age, social networking sites have grown rapidly, making them an essential tool for communicating emotions to individuals all over the world. Many people use music, video, photos, and text to express their ideas or perspectives. Sentiment analysis is inadequate in certain applications; therefore, emotion detection is necessary to accurately ascertain a person's emotional and mental condition. The degrees of sentiment analysis, different models, and the steps involved in sentiment analysis and emotion detection, challenges faced are all explained in this review study.

**Index Terms-** Natural language processing, Opinion mining, emotion detection.

## I. INTRODUCTION

Nowadays, the majority of people use the Internet and social networks to share their experiences, thoughts, and feelings. This typically results in the transmission of vast amounts of data via the Internet. However, the majority of these data are helpful when examined; for instance, the majority of industries and election campaigns rely on understanding people's ideas through communication sites and determining whether they are neutral, positive, or negative. The vast amount of information interchange on the Internet has led to the emergence of the SA. Nasukawa was the first to propose the SA concept [1]. First, the SA is utilized for natural language processing (NLP) [2], which examines the thoughts, emotions, and responses of individuals and authors on the Internet via social media platforms and commercial websites on a wide range of goods and services. Sentiment analysis, also known as opinion mining, is a large field for many scholars since it aids in categorizing thoughts and opinions as neutral, negative, or positive. Fig 1 shows types of sentiments. SA is textual research that is frequently utilized in online reviews and surveys as well as on social media. It manages comments and customer reviews on commercial websites to determine whether a product is accepted or rejected; this informs a consumer's decision and boosts sales for the business. Systems, politicians, psychologists, manufacturers, and researchers came up with new ideas in response to the emergence of diverse viewpoints on social networking sites. They then analyzed these ideas to make the best conclusions possible. Using NLP, sentiment analysis is highly effective as statistics, and using NLP, statistics, and machine learning techniques to identify and extract sentiment

material from a text unit, sentiment analysis is highly effective. Intense feelings that are directed at something or someone in reaction to internal or external events that hold special meaning for the individual are referred to as emotions. And one of the most important platforms for people to communicate their thoughts, feelings, and ideas nowadays is the internet

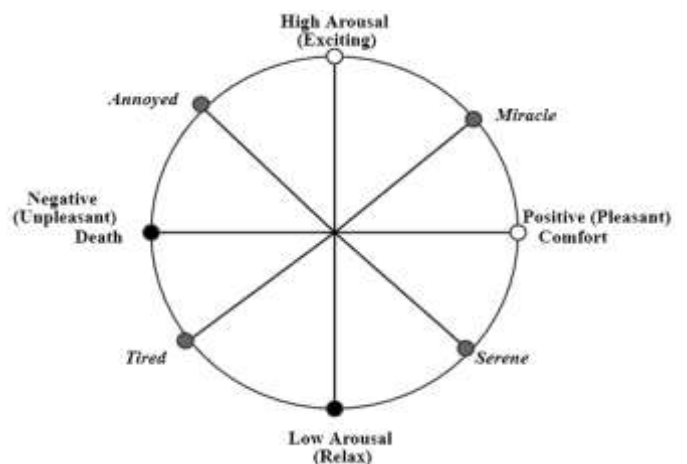


Fig 1. Types of Sentiments.

Millions of individuals use social media to share, discuss, post, and comment on every event, news story, and action that occurs worldwide. In the internet age, driven by the younger generation, the amount of data generated and shared is growing exponentially. The data generated from the year 2020 onwards is nineteen percent more than all the data generated before the year 2020 [6]

## II. STEPS FOR SENTIMENT ANALYSIS

To extract and understand emotions from textual data, sentiment analysis entails a number of methodical stages. This is a thorough guide: [3] As seen in Figure 2

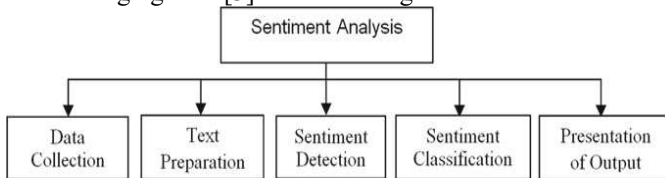


Fig 2. Steps of Sentiment Analysis

### 1. Data Collection

Compile textual information pertinent to your study's goals. Social media posts, client testimonials, survey answers, and any other text-rich platform can all be considered sources.

### 2. Text Preprocessing

Complete the following procedures to get the gathered data ready for analysis:

- **Text Cleaning:** To cut down on noise, and eliminate special letters, digits, punctuation, and superfluous symbols.
- **Tokenization:** Break up text into smaller chunks, such as words or sentences.
- **Part-of-Speech Tagging:** To determine a word's function in a sentence, assign it to its grammatical category. [20]
- **Stop Word Removal:** Get rid of words that don't offer much sense, like "and" and "the."
- **Lemmatization and Stemming:** To maintain consistency, reduce words to their most basic forms.

### 3. Sentiment Detection

Convert the previously edited text into numerical representations that can be processed by machine learning models. Typical methods include of:

- **Bag of Words (BoW):** Ignores grammar and word order and represents text based on word frequency.
- **Term Frequency-Inverse Document Frequency (TF-IDF):** This method highlights key terms by taking into account how frequently they appear in different texts. Word embedding's map words into continuous vector spaces to capture semantic meanings.

### 4. Sentiment Classification

Use algorithms to group texts according to emotion categories (such as joyful, sad, or furious) or sentiment polarity (positive, negative, or neutral).

### 5. Output Presentation

To effectively convey conclusions, display the studied data using word clouds, graphs, or charts. Data sentiment trends

and patterns can be better understood with the use of visualizations.

## III. SENTIMENT ANALYSIS METHODOLOGY

Below table discussed different sentiment analysis methodologies

Methodology	Description	Accuracy Range	Pros	Cons
Lexicon-Based	uses pre-established sentiment lexicons (such as SentiWordNet and AFINN) to infer sentiment from word polarity.	60-75 %	Domain-independent and simple to implement	Restricted in vocabulary ; has trouble with context
Rule-Based	employs heuristics and hand-crafted linguistic rules (e.g., negation handling: "not good"	65-80 %	Transparent and adaptable	Laborious creation that is difficult to generalize
Bag of Words (BoW)	Employs heuristics and hand-crafted linguistic rules (e.g., negation handling: "not good").	70-85 %	Easy to use and efficient for simple jobs.	Disregards context and word order.
TF-IDF with ML	trains ML models and extends BoW by assigning weights to words according to their significance.	75-87 %	lessens the impact of irrelevant words.	Syntax and context are not recorded.
Zero-Shot Learning (ZSL)	predicts sentiment using models (such as GPT and T5) that have been trained on general tasks	80-90 %	Very flexible; no need for labeled data.	Reduced precision on tasks relevant to a given domain

	rather than a sentiment dataset.			
Aspect-Based Sentiment Analysis (ABSA)	predicts sentiment using models (such as GPT and T5) that have been trained on general tasks rather than a sentiment dataset.	80-92 %	sentiment can be quantified.	Aspects require annotated data.
Convolutional Neural Networks (CNN)	uses convolution layers to process text by obtaining features from n-grams, frequently for sentiment analysis at the sentence level.	85-90 %	fast in extracting features	Disregard long-term reliance.
Hybrid model	combines strategies to capitalize on the advantages of several approaches (lexicon + deep learning, for example)	85-95 %	Approaches combine their finest qualities.	Difficult to optimize and put into practice.
Transformer Models (e.g., BERT, RoBERTa)	learning models to comprehend syntax and context that have been trained on large datasets.	90-97 %	Pre-trained models with high accuracy are available.	High resource needs; fine-tuning unique to a given domain.

#### IV. EMOTION MODELS AND APPLICATIONS

Human emotions are an essential component of life and are fundamental to how people see and comprehend the world. [21] [22] [23] [24]. Over the past three decades, numerous techniques have been developed to make emotion analysis easier. Three models of emotion are examined.

**Ekman's Six Basic Emotions:** This model, which is based on Paul Ekman's theory, frequently classifies emotions as surprise, fear, rage, sadness, joy, and disgust.

- **Plutchik's Wheel of Emotions:** This circular model of primary, secondary, and tertiary emotions provide a wider range and can be used to pinpoint complex emotional states.
- **Dimensional Models:** Certain frameworks classify emotions according to dimensions such as arousal (intensity) and valence (positive-negative).

#### Applications

- **Consumer Feedback Analysis:** Determining if a consumer is satisfied or dissatisfied by analyzing the feelings expressed in reviews or social media posts.
- **Healthcare:** Identifying feelings in patient accounts to aid in the diagnosis and treatment of mental health issues. [19]
- **Virtual Assistants and Chatbots:** modifying responses according to user feelings to improve user experience.

#### Challenges. in Sentiment Analysis

Here are the primary challenges in sentiment analysis

Challenge	Description	Examples
Ambiguity in Sentiment	The context can change the meaning of a word or phrase.	The word "cool" could refer to temperature or approval.
Sarcasm and Irony	It might be challenging to identify sarcastic remarks since they frequently have the opposite meaning from their literal interpretation.	"Oh great, another traffic jam!"
Domain-Specific Sentiment	Different domains may have different sentiment polarity, necessitating the use of unique models or lexicons.	"The plot was heavy" (negative in film, neutral in engineering).
Idioms and Colloquialisms	Interpreting nonliteral language or colloquial idioms can be difficult.	"Kick the bucket" (die), "over the moon" (happy).
Negation Handling	Detecting negations and their scope is difficult but critical for accurate sentiment.	"This is not a bad movie" (positive).
Mixed Sentiments	Both positive and negative feelings can be expressed in a single text.	"The food was great, but the service was awful."
Multilingual Text	Language-specific tools and methods are needed to analyze feelings in various languages.	Sentiment models trained in English may fail for French or

		Chinese.
Code-Switching	Complexity is increased when different languages are used in the same text.	"This movie was très magnifique!"
Spelling and Grammar Errors	Analysis of user-generated information is frequently hampered by typos, slang, and grammatical errors.	"This movie was gr8!"
Emojis and Hashtags	Hashtags and emojis frequently express emotions that require careful management.	☐ (positive), Fail (negative).
Aspect-Based Sentiment	It is necessary to identify the target in order to analyze sentiment about particular attributes rather than the sentiment as a whole.	"The camera is great, but the battery life is poor."

## V. CONCLUSION

The overview of various methods utilized in the field of SA is the primary topic of this work.

This study addressed the application of emotion models and the difficulties in sentiment identification, as well as the methods with accuracy in the (SA) approach for extracting and analyzing sentiments related to the polarity of positive or negative, or neutral, on the chosen issue. Sentiment analysis has grown into a crucial domain of research in natural language processing owing to its vast areas of application. This study adopted a different approach of not limiting itself to one particular kind of sentiment classification or technique but instead focused on the kinds of sentiment classification that are best suited for different types of data. This approach allowed us to present a more comprehensive and nuanced understanding of sentiment analysis. The paper discussed two major approaches to sentiment analysis

## REFERENCES

- Nasukawa Y (2003) Sentiment analysis: capturing favourability using natural language processing, IBM Almaden Research Center, CA 95120, <https://doi.org/10.1145/945645.945658>
- Mohey D (2016) A survey on sentiment analysis challenges. J King Saud Univ Eng <https://doi.org/10.1016/j.jksues.2016.04.002>
- Alessia D (2015) Approaches, tools and applications for sentiment analysis implementation Int J Comput Appl 125(3)
- An Analysis of Sentiment: Methods, Applications, and Challenges - Sharma, H.D. & Goyal, P. This paper provides a comprehensive overview of sentiment analysis techniques, their applications, and the associated challenges. Published in Eng. Proc. (2023)..
- The Sentiment Problem: A Critical Survey towards Deconstructing Sentiment Analysis - Venkit, P., Srinath, M., et al. This work critically examines 189 papers to explore sentiment analysis's sociotechnical dimensions. Published in Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing..
- Statista. (2020). Total data volume worldwide 2010-2025. [Online]. Available: <https://www.statista.com/statistics/871513/worldwidedata-created/>.
- Multimodal Sentiment Analysis Using Text and Image Data - Explores multimodal approaches integrating text and images to enhance sentiment analysis accuracy. Published in Information Fusion.
- Handling Ambiguities in Sentiment Analysis Through Context-Aware Approaches - Examines solutions for challenges like sarcasm detection and context dependency. Published in Expert Systems with Applications.
- A Study on Cross-Domain Sentiment Analysis - Discusses challenges and solutions for applying sentiment models across diverse domains. Published in ACM Transactions on Information Systems.
- Explainable AI in Sentiment Analysis: Methods and Applications - Highlights explain ability in sentiment models, emphasizing transparency and trust. Published in Journal of Artificial Intelligence Research.
- Real-Time Sentiment Analysis in Social Media - Focuses on challenges related to real-time sentiment analysis and scalable solutions. Published in Computational Intelligence and Neuroscience
- Multimodal Emotion Recognition-Poria, S., Cambria, E., Hazarika, D., & Mujumdar, N. (2017). A Review of Affective Computing: Emotion Models, Databases, and Recent Advances.
- Plutchik, R. (1980) A General Psych evolutionary Theory of Emotion. Source: Emotion: A Psychoevolutionary Synthesis
- RoBERTa and Emotion Analysis, Y., Ott, M., Goyal, N., et al. (2019). RoBERTa: A Robustly Optimized BERT Pretraining Approach
- Sentiment and Emotion in Social Media-Mohammad, S. M., & Kiritchenko, S. (2015). Using Hashtags to Capture Fine Emotion Categories from Tweets. Source: Computational Intelligence
- Challenges and Issues in Sentiment Analysis: A Comprehensive Survey - This survey identifies key technical and methodological challenges in sentiment analysis. Published in IEEE Journals & Magazines.
- Deep Learning-Based Sentiment Analysis: A Comparative Study - A detailed exploration of deep learning methods for sentiment analysis and their comparative effectiveness. Published in Applied Intelligence.

18. Sentiment Analysis: Advancements, Challenges, and Future Directions - This article focuses on advances in sentiment analysis and highlights unresolved challenges. Published in *Journal of Information Processing Systems*.
19. Carvalho, J.; Plastino, A. On the evaluation and combination of state-of-the-art features in Twitter sentiment analysis. *Artif. Intell. Rev.* 2021, 54, 1887–1936. [CrossRef]
20. Weerasooriya, T.; Perera, N.; Liyanage, S.R. A method to extract essential keywords from a tweet using NLP tools. In *Proceedings of the 2016 Sixteenth International Conference on Advances in ICT for Emerging Regions (ICTer)*, Negombo, Sri Lanka, 1–3 September 2016; IEEE: Piscataway, NJ, USA, 2016; pp. 29–34
21. Vandervoort, D. J., The importance of emotional intelligence in higher education. *Current Psychology: Development, Learning, Personality, Social*, 25(1) (2006)4–7.
22. Bagozzi, R. P., Gopinath, M., Nyer, P. U. The Role of Emotions in Marketing. *Journal of the Academy of Marketing Science*. 27(2) (1999)184–206. 10.1177/0092070399272005
23. Scotty Craig, Arthur Graesser, Jeremiah Sullins Barry Gholson , Affect and learning: An exploratory look into the role of affect in learning with AutoTutor , *Journal of Educational Media*.29:3(2004) . 241- 250. 10.1080/1358165042000283101
24. Nussbaum M., Emotions as Judgments of Value and Importance. In R. C. Solomon (Ed.), *Series in affective science. Thinking about feeling: Contemporary philosophers on emotions.* (2004). 183-199. New York, NY, US: Oxford University Press.