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SENTIMENT ANALYSIS OF ONLINE PRODUCT REVIEW USING DEEP LEARNING IN DISTRIBUTED SENSOR NETWORKS

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Abstract. Recently, sentiment analysis has been a major business practice for an organization that helps analyze online reviews of different products. An organization can understand the customer's perception of their organizational products by analyzing reviews. On the other hand, this analysis process also helps to understand the customer's emotions about the organizational products. In this process, deep learning and distributed sensor networks play crucial roles in analyzing emotions. Five different steps of this analysis will provide accurate information about the customers' emotions on products. This analysis will help increase the product's value by understanding the customer's perception of where negative feedback improves the products. Through the help of this analysis, an organization will get several benefits that enrich its organizational image. On the other hand, this analysis process will face polarity issues, tone issues, comparative sentence analysis issues, and understanding idioms and emojis issues. The implementation of live API and proper sentiment analysis tools help to increase the effectiveness of this analysis.

Key words: Distributed Sensor Networks, Machine Learning, Decision Tree Algorithm, Natural Language Processing (NLP), Computational Linguistics, Support Vector Mechanics

1. Introduction. Sentiment analysis of online product reviews refers to the automated process of understanding the opinion as well as sentiments of customers about the products [17]. Through this process, an organization can automatically analyze the online reviews from consumers about its products and services and make them sorted in terms of positive as well as negative and neutral. By using deep learning, organizations implement different algorithms such as Linear Regression, Naive Bayes, and Support Vector Machines which analyze online reviews about the products [21].

Illustrate the effectiveness of sentiment analysis, consider the case of an e-commerce platform seeking to enhance customer satisfaction. The company collected thousands of product reviews and utilized sentiment analysis techniques to extract meaningful insights. The company employed a combination of deep learning algorithms and natural language processing (NLP) tools to analyze customer reviews. The reviews were categorized as positive, negative, or neutral sentiments. The sentiment analysis process was supported by distributed sensor networks (DSN) for data collection.

By implementing sentiment analysis, the e-commerce platform gained actionable insights into customer perceptions. They identified specific pain points in their products and services, leading to targeted improvements. Negative sentiment patterns related to delivery delays were identified, prompting the company to address logistics issues. As a result, customer satisfaction scores increased by 20% over six months, leading to improved customer loyalty and increased sales.

This case study underscores the importance of sentiment analysis in understanding customer sentiments. It also highlights the value of real-time data collection through DSN, which provides timely feedback for operational improvements. By utilizing deep learning and NLP, the company identified problems and formulated effective solutions based on customer feedback. Including such a case study would provide readers with a tangible example of how sentiment analysis can drive tangible improvements in real-world scenarios.

The contribution of the research,

1. Our research introduces the integration of distributed sensor networks (DSN) to sentiment analysis, enabling real-time data collection and analysis. This innovative approach ensures that organizations promptly gain actionable insights into customer sentiments and market trends, facilitating agile decision-making.

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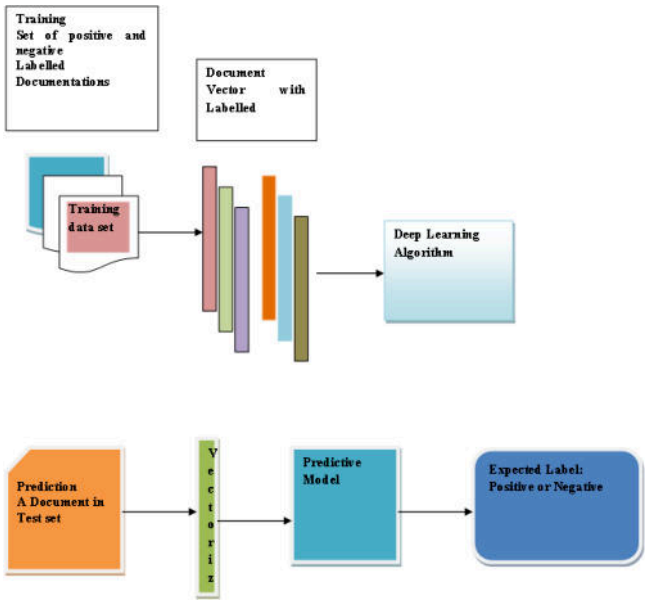

Fig. 1.1: Process of Sentiment analysis through Deep learning algorithm by using DSN

Table 1.1: Type of sentiment analysis for online products reviews

Types	**Description**
Knowledge-Based	This type of sentiment approach provides information about emanating emotion
Statistical	This approach mainly uses different types of deep learning and machine learning algorithms to ensure accuracy in the sentiment detection aspects [1].
Hybrid	This type of approach is mainly based on statistical as well as knowledge-based techniques used for sentiment detection.

2. We address the challenges posed by idiomatic expressions and emojis in sentiment analysis, enhancing the accuracy of our analysis. By employing advanced NLP techniques, we offer a comprehensive solution to capturing nuanced sentiments, which is crucial for understanding modern online communications.
3. By providing a comprehensive framework that combines deep learning algorithms with DSN, our research offers a new perspective on sentiment analysis that caters to the needs of businesses operating in rapidly changing market landscapes.

As per the above image, all the online reviews are used as data sets, documented as per their level. Here, distributed sensor networks (DSN) play a vital role in sentiment analysis through deep learning [14]. Using different ML algorithms, an organization can understand customers' expectations of its products, which helps in the product improvement segment. Here, through the predictive model, all kinds of expressions of customers on products are categorized in terms of positive and negative perspectives [5]. Organizations use different programming language expertise, including Python, machine learning, and R language. On the other hand, organizations extract information through the DSN and analyze that data through natural language processing (NLP), computational linguistics, text analytics, and classifying the polarity of the opinion processes. DSN is used as an autonomous sensor to analyze different online reviews from customers about the products and pass data and information to advanced technology through this networking system.

As per Table 1.1, in the sentiment analysis aspects, there are a total of three types of approaches used that include Knowledge based technique, statistical technique, and hybrid technique.

The heart of sentiment analysis lies in the application of deep learning algorithms. Decision tree algorithms,

Support Vector Machines (SVM), and neural networks are commonly employed to classify textual data into different sentiment categories. Decision trees, for instance, partition data based on specific features and follow a hierarchical structure to arrive at classification decisions. SVM, on the other hand, constructs hyperplanes to separate data into distinct categories. Neural networks, with their intricate layers of interconnected nodes, are known for capturing complex patterns in text data.

NLP plays a crucial role in preprocessing and understanding textual data. Techniques like tokenization, stemming, and lemmatization aid in breaking down sentences into individual words and reducing them to their root forms. Stop-word removal helps eliminate common words with little semantic value. Part-of-speech tagging allows for grammatical analysis, which is vital in accurately capturing context and meaning.

Challenges and Limitations:

1. Sentiment analysis heavily relies on the quality and diversity of training data. Biased or unrepresentative datasets can lead to skewed results.
2. Textual nuances like sarcasm and irony can be challenging for sentiment analysis algorithms to detect accurately, as they often require an understanding of contextual cues.
3. Sentences can have different meanings based on the surrounding context. Algorithms might struggle to grasp the complete context, leading to misclassification.
4. While emojis and idiomatic expressions provide rich emotional context, they can be difficult to interpret algorithmically. NLP tools might not be well-equipped to handle these elements effectively.
5. Sentiment analysis might struggle with linguistic variations, slang, and regional differences, particularly in diverse online content.
6. Different industries and domains might have specialized terminology that is not covered in general sentiment analysis models.

To mitigate some of these limitations, hybrid approaches that combine statistical and knowledge-based techniques have been explored. These approaches attempt to leverage the strengths of both methodologies to achieve more accurate sentiment analysis results. By providing an in-depth explanation of the methodologies, you equip your readers with a clear understanding of the technical underpinnings and challenges of sentiment analysis. This not only adds credibility to your work but also offers valuable insights for researchers and practitioners seeking to implement sentiment analysis effectively.

2. Objectives. The objectives of the research study are:

1. To understand the concept of sentiment Analysis of Online Product Reviews
2. To understand the five main steps of sentiment Analysis of Online Product Reviews through deep learning in DSN
3. To identify the benefits of sentiment analysis of online product reviews by using deep learning in DSN
4. To evaluate the role of deep learning and DSN in online product reviews through the sentiment analysis process
5. To Understand different challenges raised during sentiment analysis of online product reviews in DSN
6. To recommend effective strategies to increase the use of deep learning in online product reviews in DSN

3. Methodology. In this study, the secondary research method was used to understand the benefits of sentiment analysis of online product reviews through DSN and deep learning. Here a secondary data collection process was used where all the collected data is taken from authentic existing sources such as websites, books, journals, and newspapers [13, 3]. This methodology section used qualitative analysis processes to understand the different types of sentiment analysis for online product reviews. Interpretivism is the research philosophy used for this study to understand the subjective aspects of this study. Here different deep learning algorithms are used for the data analysis segment. Through the help of the analysis process, unbiased results for this study have been seen.

Our research offers a novel approach by integrating deep learning algorithms with distributed sensor networks (DSN) for sentiment analysis of online product reviews. While sentiment analysis has been extensively explored, the incorporation of DSN adds a real-time data collection dimension that enhances the accuracy and timeliness of our analysis. This unique combination not only captures customer sentiments but also provides insights into evolving trends, making our approach particularly suited for dynamic and fast-paced market environments.

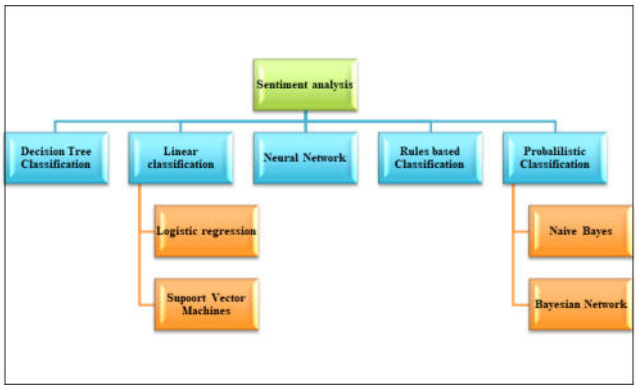

Fig. 4.1: Using different Deep learning classifications in the sentiment analysis process

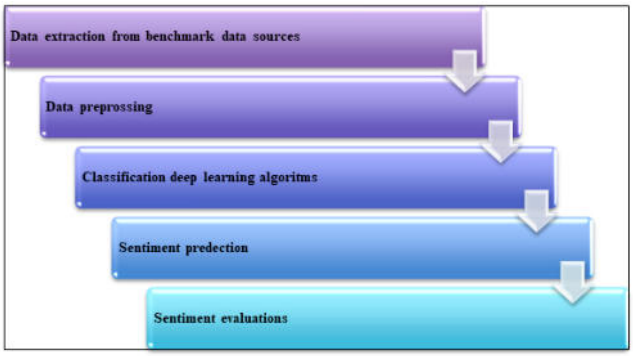

Fig. 5.1: Process of sentiment analysis through deep learning by using DSN

4. Concept of Sentiment Analysis of Online Product reviews in DBS. Sentiment analysis is an opinion-mining process that helps to understand the expression of human beings by analyzing text. By using this process, an organization can understand its product quality by analyzing the customer's reviews. The DSN helps an organization extract text from online reviews about products and all the extracted data is used as a data set [23, 24]. Through the help of the DSN networking system, all the data transfers to the deep learning aspects where different types of algorithms analyze those texts in terms of human beings' expression.

Figure 4.1 provides information about different types of deep learning processes used for sentiment analysis to analyze online product reviews. Here four different deep learning processes are used that are related to the decision tree classification, neural network, linear classification, and rules-based classification. On the other hand, logistic regression and SVM are used for the linear classification deep learning process to analyze human beings' expressions through textual language [12].

5. The Five Main Stapes of Sentiment Analysis of Online Product Reviews Through Deep Learning in DSN. In sentiment analysis, five steps help an organization evaluate sentiment from online product reviews.

Figure 5.1 provides information about the steps to complete sentiment analysis. In the first step, data is extracted from different benchmark data sources by using live API. This live API allows extracting data from the online platform of the organization. After extracting data, DSN is used to prepare data and all the extracted keywords are transferred to the deep learning process through open networking. After the transferring data, deep learning classification has been seen and different algorithms are used for sentiment prediction [18]. As per the expression of human beings, deep learning categorized the reviews in terms of positive, negative and

Table 6.1: Benefits of sentiment analysis through deep learning and DSN on online product reviews

Serial No.	Benefits
1	Help to understand the customer's perception of products
2	To get information on current market status from customers' perceptions.
3	It improved the crisis management system for an organization [22]
4	Help to understand the brand strength
5	To make a sales and marketing plan

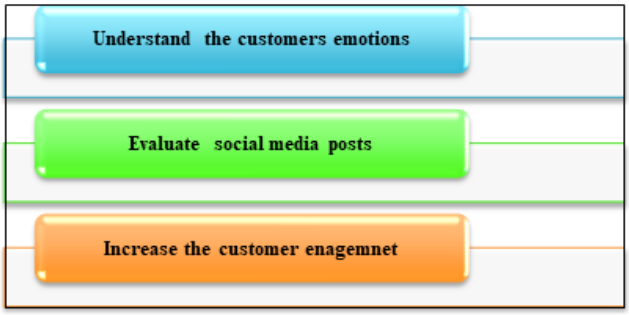

Fig. 6.1: benefits get by an organization through sentiment analysis on online product reviews

neutral. In terms of deep learning classification

6. Benefits of Sentiment Analysis of Online Products Reviews by Using Deep Learning in DSN. There are several benefits seen due to the sentiment analysis of different product reviews through the use of deep learning and DSN. Through the help of sentiment analysis, an organization understands correspondence concerns about the products from the customers. By understanding the perception of human beings about products, organizations can understand the value of products [8].

The above table provides information about the benefits of this analysis process. Here, DSN helps to extract data from the specific platform and all the extracted data analysis in terms of positive and negative polarity. Through the help of this analysis process, an organization can maintain its brand reputation by making improvements to its products. Here, online reviews are analyzed through the decision tree algorithm that analyzes the contextual expression of human beings [25]. By analyzing reviews, an organization can understand the consumer's perspective about their products which brings enhancement to the product's quality.

Figure 6.1 provides information about the benefits an organization gets by analyzing online reviews of its products. Sentiment analysis brings enhancement to customer engagement by fulfilling the customer extraction. This analysis process provides practices to understand human beings' emotions for products [18].

7. The Role of Deep Learning and DSN in Online Product Reviews through the Sentiment Analysis Process. In sentiment analysis, deep learning and DSN play a crucial role. Here these two advanced technologies provide their contribution to the data fusing and collaboration segment. On the other hand, the deep learning process provides effective practices to understand human beings' expressions through contextual segments.

Table 7.1 provides information about the role of the deep learning process and DSN in the sentiment analysis process. Here, this analysis helps in the textual analysis and classification segment. Through the classification, organizations can categorize online reviews in terms of neutral as well as positive and negative feedback. By understanding the customer's negative reviews, an organization can make improvements to products that help to increase customer engagement [16]. On the other hand, DSN helps to extract human beings' expressed data and transfer it to the deep learning process where different types of linear algorithms are used to provide accurate information about the products to the organization. The deep learning processes understand the value

Table 7.1: Role of DSN and deep learning in the sentiment analysis for online product reviews

Serial No.	Importance of deep learning and DSN
1	Textual analytics and classification
2	Understand the Value of expression
3	Help to understand the market trend by understanding the customers' perspective on products [11]

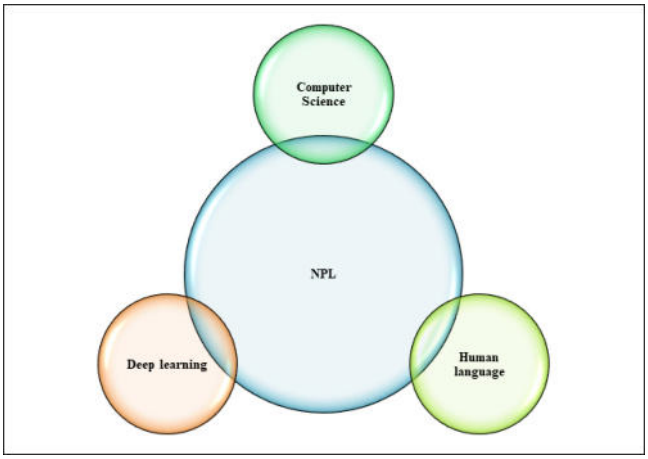

Fig. 7.1: Natural language processing (NLP) in sentiment analysis

of human beings that bring revolutionary changes to forecast the market trend.

Figure 7.1 offers information about the NPL sentiment analysis that provides organizational practices to analyze human beings' opinions about products. In NPL, DSN provides a set of data to the Deep learning process which helps in polarity classification. In terms of current market analysis, sentiment analysis plays a vital role. Here, DSN transferred market-related data to machine learning and all the data was analyzed through linear algorithms that provide effective market forecasting to the organization [9]. On the other hand, through deep learning, an organization can analyze large amounts of valuable data in a fraction of a second through an automatic process. Here this analytic process

8. Challenges Raised during Sentiment Analysis of Online Product Reviews in DSN. In sentiment analysis, there are different types of issues.

Table 8.1 provides information about the challenges raised in sentiment analysis through deep learning and DSN. In the review, if negations words such as cannot, never, and were not then deep learning classification did not respond as per the words as a result, the sentiment analysis did not happen in the proper ways. On the other hand, sometimes due to the employee's bias, barriers are raised to the sentiment analysis of online product reviews for an organization [19].

9. Effective Strategies to Increase the Use of Deep Learning in Online Product Reviews in DSN. In terms of mitigation of issues, an organization should take some effective initiatives that will increase the effectiveness of sentiment analysis for online reviews on products.

The above image provides information about the strategies taken by an organization to increase the effectiveness of sentiment analysis. Here, the organization should implement effective sentiment analysis software to understand the difficult written word. On the other hand, the implementation of topic-based sentiment analysis provides effective round-based analysis that understands complex reviews of products [10]. Through this initiative, an organization can mitigate polarity issues that are raised during sentiment analysis. To solve emoji issues, an organization should use an improved API. Through effective API, deep learning can understand different types of special characters as well as emojis. By providing training in different algorithm models,

Table 8.1: Challenges faced raised in sentiment analysis for products reviews

Factor	Issue
Tone	The deep learning process faced issues during sentiment analysis due to interpreting verbally. Here, due to the large volume of data, sometimes, the deep learning process did not recognize subjective as well as objective responses in the online product reviews.
Polarity	Some words such as hate and love provide negative and positive polarity scores. If there are any confusing words seen in the data set then sentiment analysis did not happen effectively.
Emojis	In the online reviews, if there are any emojis seen then it creates barriers to the analysis process. Here NPL provides a language-specific analysis process as a result; sentiment analysis did not happen positively [20].
Idioms	Deep learning and artificial intelligence did not understand figures of speech as a result, when idioms were used in online product reviews, deep learning programs did not understand the expressions of human beings.

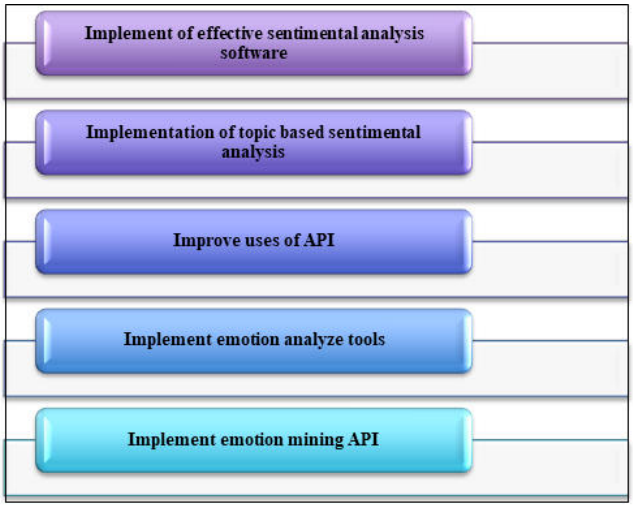

Fig. 9.1: Recommended strategies to increase the effectiveness of sentiment analysis

an organization can increase the functionality of sentiment analysis that provides analysis of human beings' expressions about the organizational products. By analyzing product value, an organization can understand the importance of products in the market that will help to get competitive advantages in the current market.

To mitigate the negation words issue, the organization should provide training to understand the double negation words as a result, understanding the human being expressed through textual context has been seen [26]. On the other hand, text analytics helps an organization reduce biases. Here, this analytical tool can understand the real emotions of employees through the help of a feedback system that eliminates human beings' errors.

10. Result. Distribution sensor network increases the sales of different organizations. Deep learning and analysis process helps recognize the customers' satisfaction level. Sentiment analysis is essential to know the honest feedback of the users. Sentiment analysis is important for all organizations as this represents the satisfaction level of the customers. The results and reviews of the customer have been used as the resources of the analysis. These reviews help to detect the quality of the different products and services that satisfy the customers. According to the view of [11], customer satisfaction could be analyzed using the machine and proper algorithm using online reviews. Online reviews suggest product quality and new buyers should check all the reviews before buying any type of commodity. Based on the views of [2], understanding of all types of

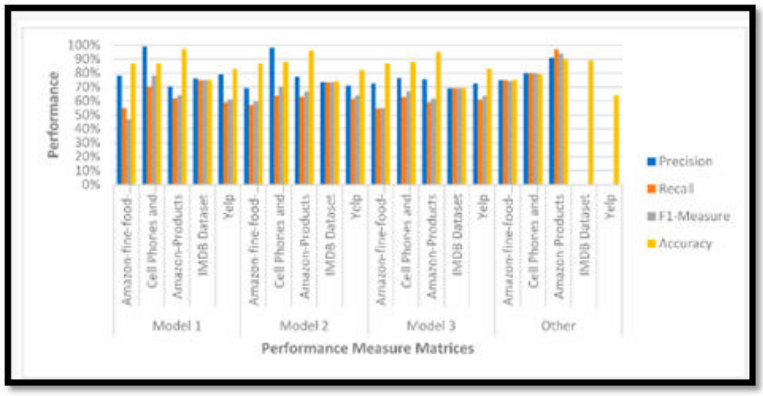

Fig. 10.1: Performance measure matrices

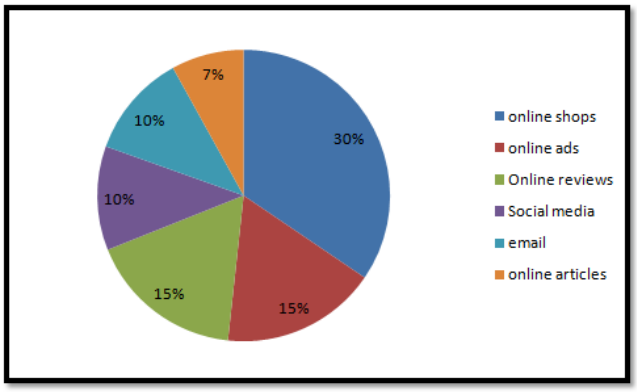

Fig. 10.2: Importance of different sources of reviews

reviews helps the organization to bring new modifications for increasing the quality of the products. This helps the organizations to understand the problems that face the customers and through understanding the reviews received from the online sources.

The above figure 10.1 has represented the precision, recall, F1 measure and accuracy. All these things are related to customer feedback on the different products of these companies. Precision values of the organizations represent the preciseness of the work and they are used to develop the product through maintaining the quality. Based on the views of [7], sentimental analysis totally depends on the nature of products and such as the quality of the products. The preciseness of Amazon fine food is 78% and the cell phone companies are 100%. This demarcates the satisfaction level of the employees. The main criteria of sentiment analysis are to examine the different openings of the customer from different sources. Customer satisfaction is demarcated as the most essential component for an organization. This represents the results of the product that is produced by the organization. The organizations are used to analyze this to change the things on the product based on the negative reviews on the product.

The figure represents the importance of different sources after analysis. Online shops are used by 30% of customers. The other sources are online advertisements which are used by the existing customers 15%, online reviews 15%, 10% from social media, email 10%, and 7 % by online articles. This denotes that the sources of the information used by the customers are not equally valued. The importance of different sources of information about the products are online shops, online advertisements, reviews, email, online articles, and email. People used to verify the quality of products by understanding the reviews. According to the views of

[14], customer satisfaction and emotions are related to the quality and longevity of the products. The sales and the brand value of the organization depend on the sales, support, and quality of the products. Based on the views of the organizations used to analyze their review to create the changes and solve the issues faced by the customers. This process of experiment helps the organization to determine the happiness and satisfaction of the customers. The deep learning on this content helps analyze the actual impact of the organizational development and the market share. According to the views of [15], understanding the customer's feedback is important for an organization to increase its market share. This process helps different organizations to analyze the impact of their products on the customer. Good customer reviews help motivate customers to buy high-rated products. Based on the views of [7], analysis of customer satisfaction is complicated as this includes negative as well as positive reviews. This study has found that the satisfaction level could be demarcated from the different sources and used by the organization for understanding their performance.

11. Problem Statement. Organizations should enforce effective API as well as proper sentiment analysis software to get effective analysis processes for online reviews from customers and stakeholders [6]. On the other hand, the real-time process of data is another issue associated with this study that mitigates through the help of the implementation of NPL. Analysis of online product reviews is one of the major and crucial tasks for a particular business that helps to understand the value of products as well as the current trend of data. In recent days, the increasing volumes of online reviews on products created barriers to the smooth sentiment analysis process by using deep learning and DSN [4]. Here, the due to improper infrastructure creates barriers to sentiment analysis. The main issue is to analyze a large volume of data with comparative sentences. Computational linguistics also helps to solve issues of DSN during transferring large volume data that enriches the effectiveness of sentiment analysis for online product reviews, through sentimental analysis, an organization can understand the customer expectation on its products that can improve the sales activities for the organization.

12. Conclusion. Sentiment analysis emerges as a transformative analytical process that revolutionizes the evaluation of product reviews for organizations. This method unfolds through five pivotal steps, guiding the meticulous analysis of textual content present in reviews. The essence lies in comprehending the perspectives of individuals, enabling organizations to glean profound insights into customer sentiments regarding their offerings. Unraveling these sentiments involves the judicious application of diverse algorithms, notably decision tree algorithms and Support Vector Machines (SVM). These sophisticated computational tools facilitate the dissection of customer feedback, delineating opinions into the dimensions of positivity, negativity, and neutrality. Such insightful categorization empowers organizations with a comprehensive understanding of their customers' nuanced feedback, transcending the conventional binary categorization.

The ramifications of sentiment analysis are far-reaching, underpinning several compelling benefits for organizations. Notably, it offers a panoramic view of customers' viewpoints, paving the way for product enhancement and strategic improvements. Moreover, this analysis serves as a lighthouse, guiding crisis management endeavors through the early detection of concerns and grievances. The strategic foundation is further fortified through the construction of effective marketing blueprints, intricately aligned with the tenor of customers' sentiments.

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REFERENCES

[1] E. S. Alamoudi and N. S. Alghamdi, *Sentiment classification and aspect-based sentiment analysis on yelp reviews using deep learning and word embeddings*, Journal of Decision Systems, 30 (2021), pp. 259–281.

[2] M. Andronie, G. Lăzăroiu, M. Iatagan, C. Uță, R. Ștefănescu, and M. Cocoșatu, *Artificial intelligence-based decision-making algorithms, internet of things sensing networks, and deep learning-assisted smart process management in cyber-physical production systems*, Electronics, 10 (2021), p. 2497.

[3] V. B, M. S, P. N, J. L, N. V, and K. S, *Artificial conversational entity with regional language*, in 2022 International Conference on Computer Communication and Informatics (ICCCI), 2022, pp. 1–6.

[4] M. Berrimi, M. Oussalah, A. Moussaoui, and M. Saidi, *Attention mechanism architecture for arabic sentiment analysis*, ACM Transactions on Asian and Low-Resource Language Information Processing, 22 (2023), pp. 1–26.

[5] S. Chatterjee, D. Goyal, A. Prakash, and J. Sharma, *Exploring healthcare/health-product ecommerce satisfaction: A text mining and machine learning application*, Journal of Business Research, 131 (2021), pp. 815–825.
[6] D. Cirqueira, F. Almeida, G. Cakir, A. Jacob, F. Lobato, M. Bezbradica, and M. Helfert, *Explainable sentiment analysis application for social media crisis management in retail*, (2020).
[7] K. Dashtipour, M. Gogate, A. Adeel, H. Larijani, and A. Hussain, *Sentiment analysis of persian movie reviews using deep learning*, Entropy, 23 (2021), p. 596.
[8] R. de Kervenoael, R. Hasan, A. Schwob, and E. Goh, *Leveraging human-robot interaction in hospitality services: Incorporating the role of perceived value, empathy, and information sharing into visitors' intentions to use social robots*, Tourism Management, 78 (2020), p. 104042.
[9] S. S. Deshmukh, *Progress in machine learning techniques for stock market movement forecast*, in Proceedings of the International Conference on Applications of Machine Intelligence and Data Analytics (ICAMIDA 2022), vol. 105, Springer Nature, 2023, p. 69.
[10] A. M. Jacks, *A Study into How Elementary School Principals Across Virginia Reduce or Eliminate Exclusionary Discipline for Students with Disabilities*, PhD thesis, Virginia Tech, 2019.
[11] P. K. Jain, R. Pamula, and G. Srivastava, *A systematic literature review on machine learning applications for consumer sentiment analysis using online reviews*, Computer science review, 41 (2021), p. 100413.
[12] M. L. Joshi and N. Kanoongo, *Depression detection using emotional artificial intelligence and machine learning: A closer review*, Materials Today: Proceedings, 58 (2022), pp. 217–226.
[13] A. O. U. Kalu, L. C. Unachukwu, and O. Ibiam, *Accessing secondary data: A literature review*, (2019).
[14] K. Kottursamy et al., *A review on finding efficient approach to detect customer emotion analysis using deep learning analysis*, Journal of Trends in Computer Science and Smart Technology, 3 (2021), pp. 95–113.
[15] S. Kumar, M. Gahalawat, P. P. Roy, D. P. Dogra, and B.-G. Kim, *Exploring impact of age and gender on sentiment analysis using machine learning*, Electronics, 9 (2020), p. 374.
[16] H. Li, K. L. Xie, and Z. Zhang, *The effects of consumer experience and disconfirmation on the timing of online review: Field evidence from the restaurant business*, International Journal of Hospitality Management, 84 (2020), p. 102344.
[17] J. Luo, S. Huang, and R. Wang, *A fine-grained sentiment analysis of online guest reviews of economy hotels in china*, Journal of Hospitality Marketing & Management, 30 (2021), pp. 71–95.
[18] C. Marechal, D. Mikolajewski, K. Tyburek, P. Prokopowicz, L. Bougueroua, C. Ancourt, and K. Wegrzyn-Wolska, *Survey on ai-based multimodal methods for emotion detection.*, High-performance modelling and simulation for big data applications, 11400 (2019), pp. 307–324.
[19] M. S. Neill and S. A. Bowen, *Ethical listening to employees during a pandemic: new approaches, barriers and lessons*, Journal of Communication Management, 25 (2021), pp. 276–297.
[20] N. J. Prottasha, A. A. Sami, M. Kowsher, S. A. Murad, A. K. Bairagi, M. Masud, and M. Baz, *Transfer learning for sentiment analysis using bert based supervised fine-tuning*, Sensors, 22 (2022), p. 4157.
[21] A. M. Rahat, A. Kahir, and A. K. M. Masum, *Comparison of naive bayes and svm algorithm based on sentiment analysis using review dataset*, in 2019 8th International Conference System Modeling and Advancement in Research Trends (SMART), IEEE, 2019, pp. 266–270.
[22] G. A. Ruz, P. A. Henríquez, and A. Mascareño, *Sentiment analysis of twitter data during critical events through bayesian networks classifiers*, Future Generation Computer Systems, 106 (2020), pp. 92–104.
[23] M. Safaei, S. Asadi, M. Driss, W. Boulila, A. Alsaeedi, H. Chizari, R. Abdullah, and M. Safaei, *A systematic literature review on outlier detection in wireless sensor networks*, Symmetry, 12 (2020), p. 328.
[24] B. Vivek, A. Arulmurugan, S. Maheswaran, S. Dhamodharan, A. S. Dharunash, and N. Gowtham, *Design and implementation of physical unclonable function in field programmable gate array*, in 2023 8th International Conference on Communication and Electronics Systems (ICCES), 2023, pp. 152–158.
[25] S. Zad, M. Heidari, J. H. Jones, and O. Uzuner, *A survey on concept-level sentiment analysis techniques of textual data*, in 2021 IEEE World AI IoT Congress (AIIoT), IEEE, 2021, pp. 0285–0291.
[26] B. Zhang, J. Zhu, and H. Su, *Toward the third generation artificial intelligence*, Science China Information Sciences, 66 (2023), p. 121101.

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