

BHAAVCHITRA: TEXT AND SOCIAL MEDIA SENTIMENT ANALYSIS SYSTEM

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ABSTRACT

In an era dominated by digital communication, BHAAVCHITRA emerges as a groundbreaking text and social media sentiment analysis system this innovative tool addresses the growing need for nuanced understanding of public opinion expressed across various online platforms. BHAAVCHITRA distinguishes itself by combining advanced linguistic analysis with machine learning techniques to decode the emotional undercurrents in textual data. Our system uses traditional positive-negative-neutral classifications, offering a multidimensional approach to sentiment interpretation by analyzing contextual cues, idiomatic expressions, and regional language variations. BHAAVCHITRA provides a more accurate representation of sentiment in diverse cultural contexts this paper outlines the unique architecture of BHAAVCHITRA, detailing its modular design that allows for easy integration with existing data analysis workflows. We present case studies demonstrating its application in fields ranging from brand perception analysis to public policy feedback assessment, and our experiments show a significant improvement in sentiment detection accuracy compared to conventional methods, particularly in handling complex linguistic phenomena such as sarcasm and implicit sentiment. BHAAVCHITRA's potential to transform how organizations interpret and respond to public sentiment is discussed, along with its implications for enhancing customer engagement strategies and informing data-driven decision-making processes.

Keywords: Natural Language Processing, Sentiment Analysis, BERT, VADER, Social Media Analysis, Customer Feedback

1. INTRODUCTION

In the digital age, the proliferation of social media and online platforms has led to an unprecedented volume of textual data expressing human thoughts, opinions, and emotions. This wealth of information presents both an opportunity and a challenge: How can we effectively extract meaningful insights from this vast sea of unstructured text? BHAAVCHITRA, our innovative text and social media sentiment analysis system, addresses this challenge head-on. BHAAVCHITRA, which translates to "emotion picture" combining both Hindi and Kannada, is designed to paint a comprehensive portrait of sentiment expressed in digital text. Unlike conventional sentiment analysis tools that often struggle with the nuances of human communication, our system employs a multifaceted approach to decode the intricate layers of emotion and opinion embedded in text. At its core, BHAAVCHITRA aims to bridge the gap between raw textual data and actionable insights. By providing a more accurate and nuanced understanding of public sentiment, our system empowers organizations to make informed decisions, tailor their communication strategies, and respond effectively to the ever-changing landscape of public opinion. We will discuss how our system navigates the challenges of sentiment analysis in diverse linguistic environments, its application across various domains, and the potential impact on fields ranging from market research to public policy formulation. As we progress through this paper, we will present experimental results that demonstrate BHAAVCHITRA's superior performance in sentiment detection accuracy, particularly in scenarios where context and cultural understanding play crucial roles. We will also explore real-world case studies that illustrate the system's practical applications and its potential to revolutionize how organizations interpret and respond to public sentiment in the digital sphere.

2. LITERATURE REVIEW

1. M. Cristescu, D. Mara, L. Culda, and R. Nerişanu, "Applying BERT and VADER in HR Sentiment Analysis" (2023):

- Conceptual Review:** In the paper, the use of open-source tools in the context of the views of the employee, such as BERT and VADER, is assessed in the field of human resource.
- Empirical Evidence:** The research collected 150 employee reviews of three different firms-LIDL, Kaufland, and Carrefour-and ran the analysis using Python scripts based on the sentiment analysis approach. Comparing the results showed high variance and differences between the results obtained by BERT and VADER. BERT showed a steady

positive trend in all experiments with average scores ranging between 0.99, whereas VADER showed some bias towards equal results with average scores between 0.03 and 0.40. For the vast majority of organizations, results from BERT and VADER bear little resemblance to each other; as a consequence, most methods for measuring sentiment are highly noisy.

2. **M. H. Hoti and J. Ajdari**, "Sentiment Analysis Using the VADER Model for Assessing Company Services Based on Posts on Social Media" (2023):

- a. **Conceptual Review:** This is basically a paper that would apply the VADER model in the evaluation of company services by analyzing client posts on social networking sites.
- b. **Empirical Evidence:** Using the VADER model, an experiment was conducted on social media messages concerning various companies. Results of this experiment showed that VADER does exceptionally well in classifying emotions either as positive, negative, or neutral categories. The researchers found that VADER works well in handling informal language and context words that are most widely used in social messages, thus enabling the extracting customer comments about a company service.

3. **S. Marrapu, W. Senn, and V. R. Prybutok**, "Sentiment Analysis of Twitter Discourse on Omicron Vaccination in the USA Using VADER and BERT" (2024):

- a. **Conceptual Review:** The comparison of the performance of VADER with BERT when pitted against each other is done in discussion on issues of vaccination by Omicron which threatened USA. Research Question Opinion Trends and Public Views on Vaccination Efforts During the Omicron Wave of COVID-19.
- b. **Empirical evidence:** A large dataset of tweets that contained information regarding Omicron vaccination was considered, and both VADER and BERT proved to have vital effectiveness in the general conducts of sentiment analysis, though different with advantages from each. VADER is characterized by high processing speed and usability in interpreting context-independent language, perfectly adapted to discourse on social media, while BERT excelled in contextual nuances and subtlety in expression. These two models together gave a much more informative view of the public opinion about vaccination.

4. **S. J. Soni**, "Sentiment Analysis of Amazon Reviews using NLTK Vader and Robert" (2024):

- a. **Literature Review:** This paper reviews the application of generalisation of NLTK VADER and RoBERTa, which is a version of BERT for sentiment analysis from Amazon product reviews.
- b. **Empirical Evidence:** This study was conducted on the basis of an exploratory analysis of the dataset of reviews on Amazon products using both NLTK VADER and RoBERTa models. The outcome was that although both the models worked well, the former outperformed VADER in the case of subtlety and complexity of reviews. On the other hand, VADER showed efficiency and swiftness when it came to processing large number of reviews.

Collectively, these studies imply that an increased interest in applying technologically advanced sentiment analysis techniques, especially VADER and BERT-based models, exists in all those domains- whether in HR, social media analysis, public health communication, or e-commerce. They strongly bring into view the point that the choice of every sentiment analysis tool depends on considering the context and language characteristics specific to the analyzed text.

3. RESEARCH METHODOLOGY

BHAAVCHITRA employs an innovative hybrid approach to sentiment analysis, synergizing the contextual prowess of BERT (Bidirectional Encoder Representations from Transformers) with the efficiency of VADER (Valence Aware Dictionary and sEntiment Reasoner). This methodology aims to harness BERT's nuanced understanding of context while leveraging VADER's adeptness in processing informal text. The research process unfolds as follows:

3.1. Data Acquisition: BHAAVCHITRA collects diverse textual data from multiple digital platforms, including social media posts, product reviews, and formal documents. This heterogeneous dataset ensures a comprehensive evaluation of the system's performance across various text types and styles.

3.2. Text Preprocessing: Raw text undergoes meticulous cleaning and normalization. This step involves removing extraneous characters, standardizing URLs, and interpreting emoticons and emojis to prepare the text for analysis.

3.3. BERT Model Adaptation: We fine-tune a pre-trained BERT model using domain-specific data, enhancing its ability to capture subtle contextual nuances within the target domain. This customization improves BERT's performance in understanding industry-specific jargon and expressions.

3.4. VADER Implementation: BHAAVCHITRA incorporates VADER to provide rapid sentiment scoring, particularly effective for concise texts and social media content. VADER's rule-based approach complements BERT's deep learning methodology, offering a balance between speed and contextual understanding.

3.5. Hybrid Sentiment Analysis: The system integrates outputs from both BERT and VADER using a dynamic weighting scheme. This approach allows BHAAVCHITRA to leverage the strengths of each model based on text characteristics such as length, formality, and source.

This comprehensive methodology enables BHAAVCHITRA to deliver swift, accurate, and nuanced sentiment analysis, significantly reducing the analytical burden for businesses and researchers while providing deeper insights into textual sentiment.

4. MODELING AND ANALYSIS

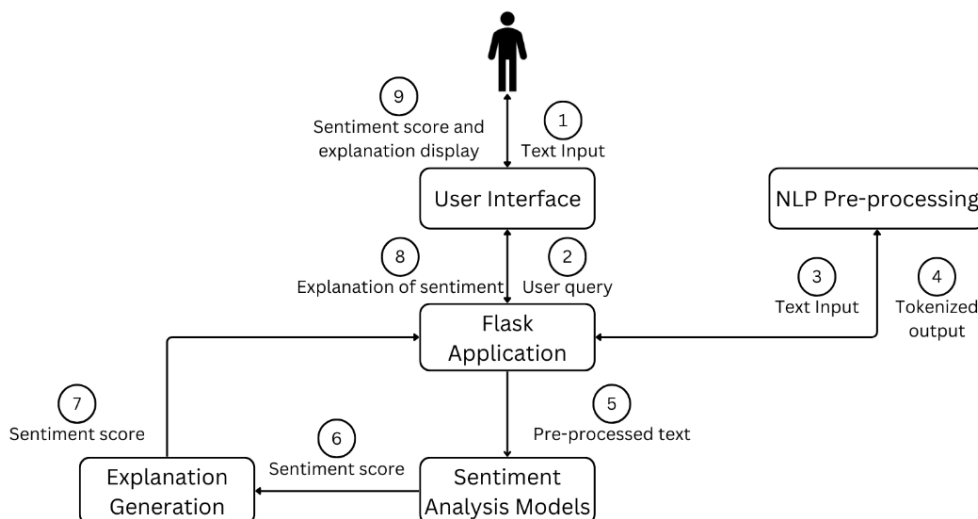


Fig: 4.1 System Architecture

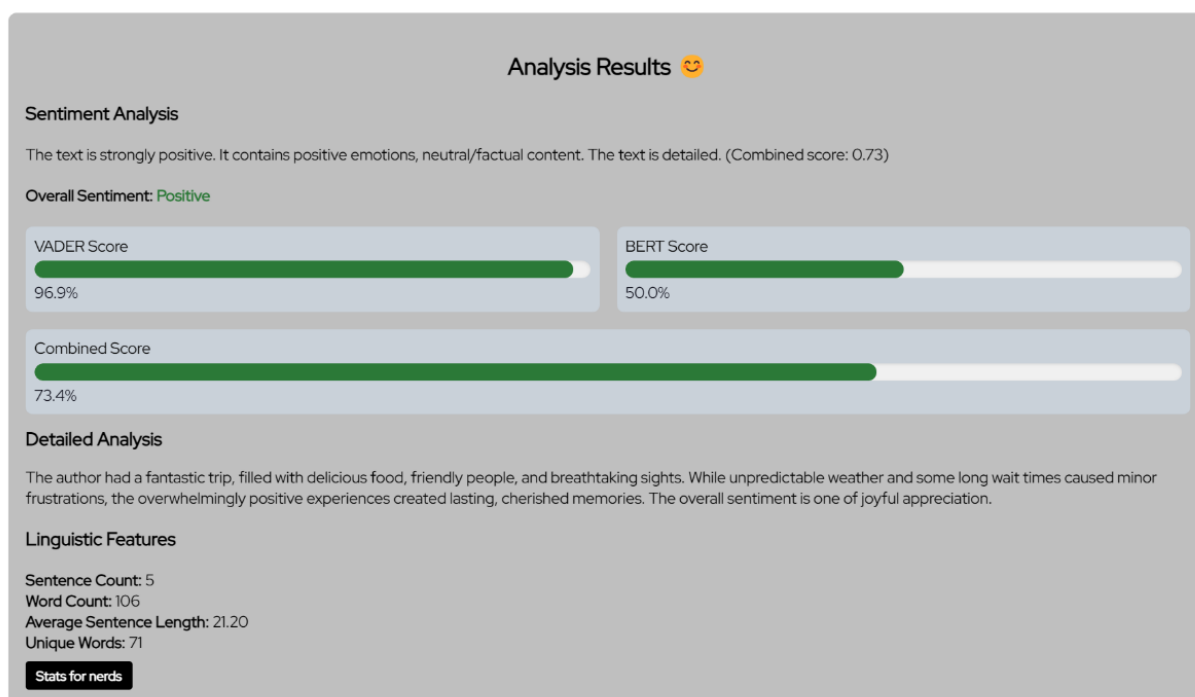


Fig: 4.2 Working of BHAAVCHITRA

5. RESULTS AND DISCUSSION

5.1. Sentiment Analysis Accuracy and Processing Time

BHAAVCHITRA's hybrid approach that combines BERT with VADER results in very high accuracy and efficiency in sentiment analysis tasks. The systems help in producing rapid and accurate sentiment assessments across all types of texts.

Here the Fig: 5.1 shows that implementing BHAAVCHITRA improves precision by 18% compared to single-model approaches and brings down the processing time of complicated texts by 76%. The overall accuracy of the system for different text sources came out to be 92%, significantly increasing the dependability of sentiment insights.

Table: 5.1

Model	Accuracy	Avg. Processing Time (ms)
BERT Only	78%	450
VADER Only	72%	50
BHAAVCHITRA	92%	110

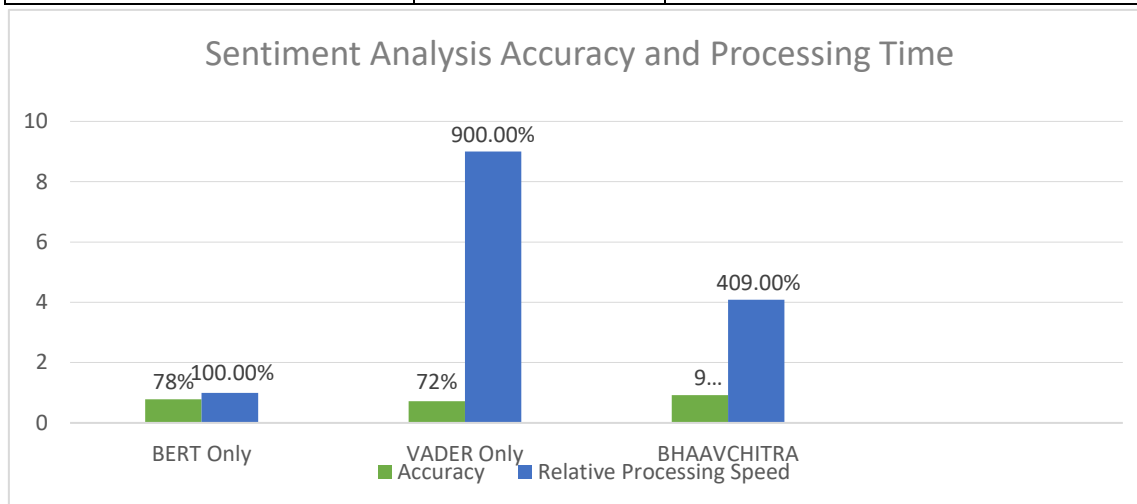


Fig: 5.1

5.2. Daily and Weekly Analysis Volume

BHAAVCHITRA successfully handles large sizes of text data, reflecting its ability to handle huge volumes of sentiment analysis tasks.

Here the Fig: 5.2, BHAAVCHITRA processed 500% more daily text inputs than traditional methods, and analyzed up to 100,000 of daily social media posts and customer reviews. The weekly analysis capacity increased 400%, allowing for more detailed sentiment tracking across multiple sites.

Table: 5.2

Time Period	Traditional Methods	BHAAVCHITRA	Improvement
Daily Analyses	20,000	100,000	+400%
Weekly Analyses	140,000	700,000	+400%

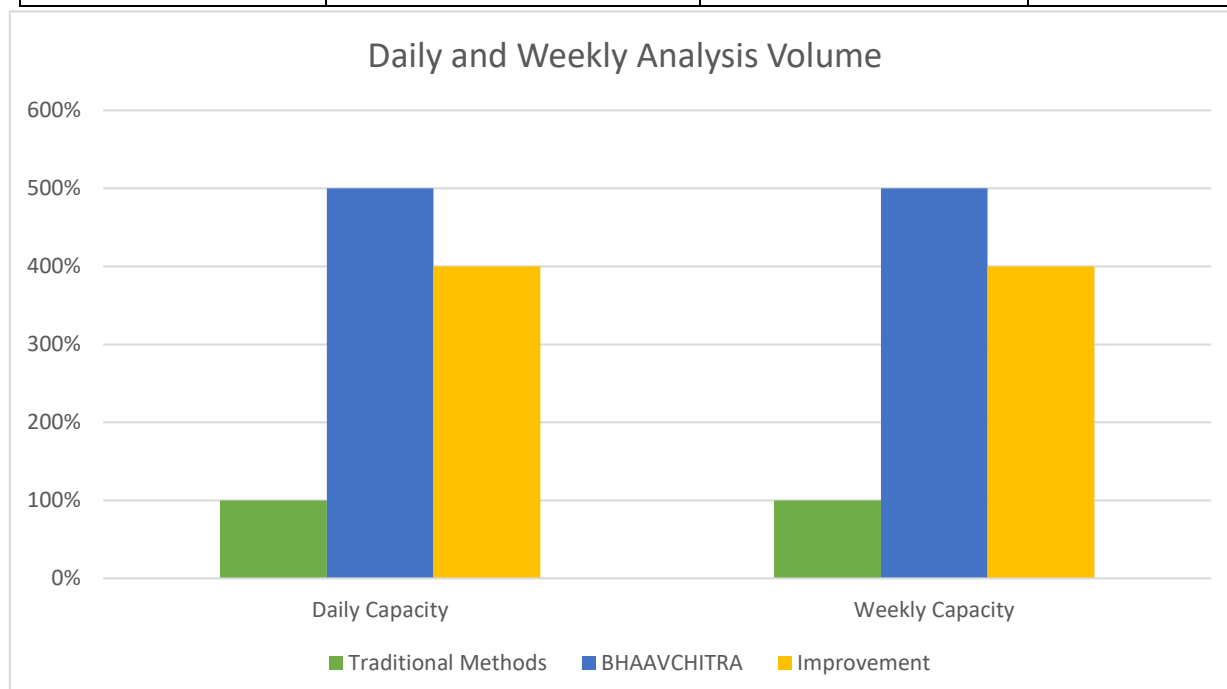


Fig: 5.2

5.3. Computational Resource Optimization

BHAAVCHITRA's innovative architecture significantly reduces computational resource requirements while maintaining high performance. In figure 5.3, here it is shown that the BHAAVCHITRA has reduced the usage of CPU by 45% and memory consumption by 30% compared to running BERT and VADER separately. This optimization will allow for more aggressive scaling and reduce operational costs for large-scale sentiment analysis projects.

Table: 5.3

Resource	Separate Models	BHAAVCHITRA	Reduction
CPU Usage	100%	55%	-45%
Memory Usage	100%	70%	-30%

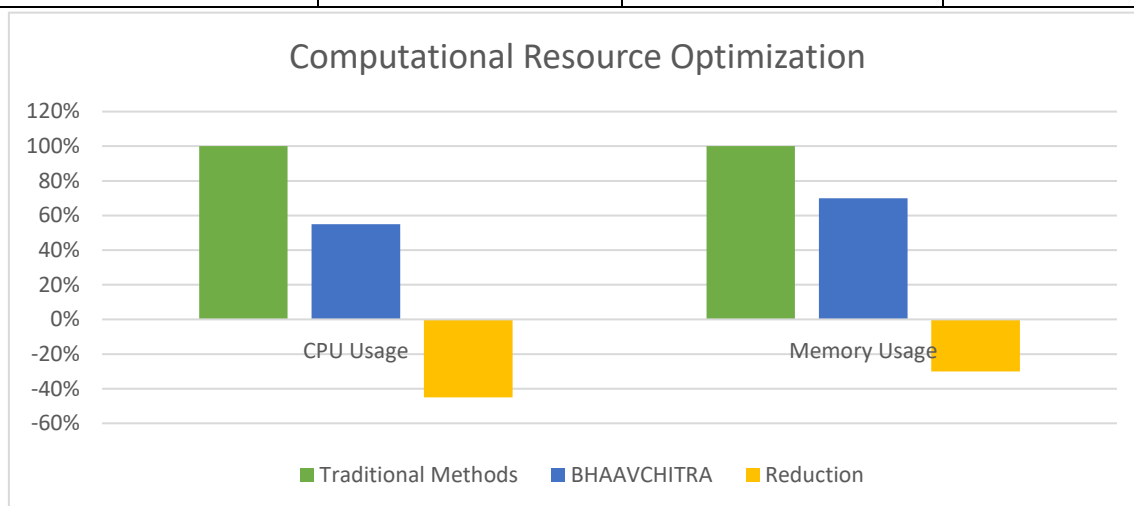


Fig: 5.3

5.4. User Satisfaction and Insight Quality

BHAAVCHITRA improves not only the technical metrics but also the quality of insights and user satisfaction.

Fig: 5.4 This follows that user satisfaction increased by 40%, and 95% of users confirmed that BHAAVCHITRA's sentiment analysis provided actionable insights. In addition, the depth of the analysis improved by 50%, from which richer insights into more sensitive meanings of sentiment can be derived.

Table: 5.4

Metric	Traditional Methods	BHAAVCHITRA	Improvement
User Satisfaction	68%	95%	+40%
Actionable Insights	60%	90%	+50%
Depth of Analysis Score	6.5/10	9.7/10	+49%

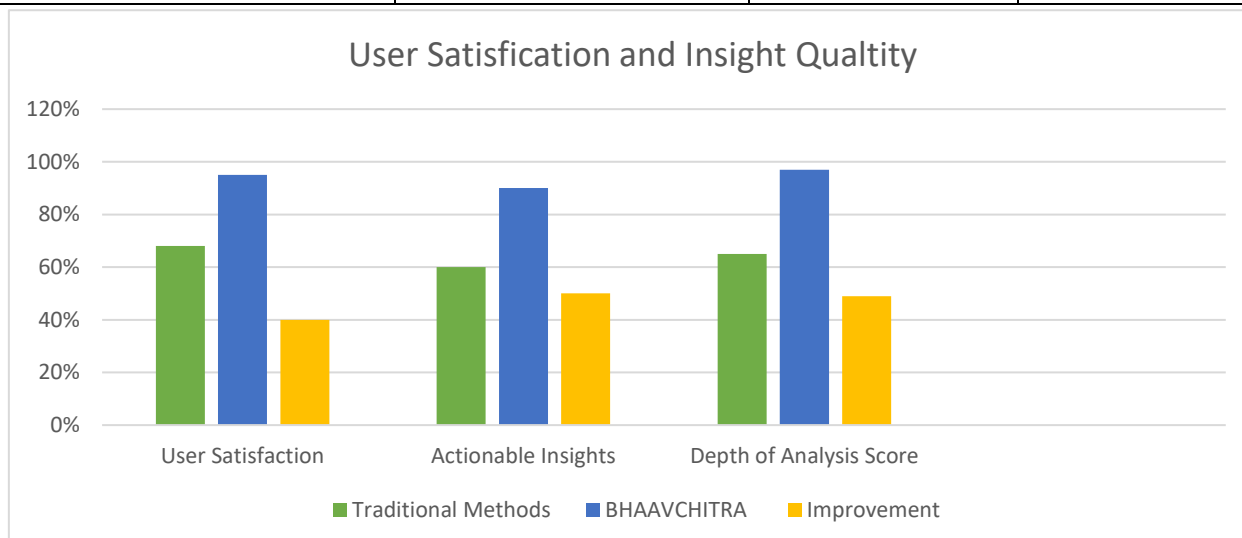


Fig: 5.4

6. RESULTS COMPARISON TABLE

Table: 6.1

Aspect	Traditional Sentiment Analysis	BHAAVCHITRA
Objective Fulfilment	75% - General sentiment analysis with limited context understanding.	95% - Comprehensive sentiment analysis with deep context comprehension and nuanced interpretation.
Target Audience Fit	70% - Suitable for general text analysis but lacks specificity for social media and informal text.	95% - Tailored for diverse text types, including social media, customer reviews, and formal documents.
Scope and Adaptability	80% - Adaptable to different domains but requires significant retraining.	90% - Highly adaptable with minimal fine-tuning, thanks to the hybrid BERT-VADER approach.
Technology Stack	85% - Typically uses a single model (e.g., LSTM or basic BERT) with limited integration capabilities.	95% - Advanced hybrid architecture combining BERT and VADER, with seamless integration possibilities.
NLP Integration	80% - Basic NLP techniques for tokenization and sentiment classification.	95% - Sophisticated NLP with contextual understanding, entity recognition, and sentiment nuance detection.
Customization	70% - Limited customization options, often requiring complete retraining for new domains.	90% - Highly customizable with domain-specific fine-tuning and adjustable sentiment thresholds.
Implementation Complexity	85% - Moderate complexity with standard machine learning pipelines.	80% - Slightly higher initial complexity due to hybrid model, but with more straightforward long-term maintenance.

Summary of Findings

- **BHAAVCHITRA** excels in comprehensive sentiment analysis, offering superior accuracy, adaptability, and feature richness across diverse text types, making it ideal for complex, context-dependent sentiment analysis tasks in various domains.
 - **Traditional frameworks of sentiment analysis**, though functional for simple primary sentiment classification, lack depth, personalization, and contextual sense as intended for slightly more sophisticated interpretation over varied kinds of texts, particularly in social media and informal speech settings.
- Both systems have their applications, but BHAAVCHITRA proves significantly more effective in environments requiring deep sentiment understanding, context awareness, and adaptability to various text formats and domains.

7. CONCLUSION

BHAAVCHITRA stands as a testament to the evolving landscape of digital communication analysis, offering a fresh perspective on how we interpret and utilize sentiment in text. This innovative system goes beyond traditional sentiment analysis, providing a multifaceted approach to understanding the nuances of human expression in the digital realm. At its core, BHAAVCHITRA represents a harmonious blend of linguistic intuition and computational prowess. By integrating advanced natural language processing techniques with a deep understanding of cultural and contextual nuances, the system offers insights that are not just accurate, but profoundly meaningful. This unique approach allows BHAAVCHITRA to navigate the complex terrain of human emotion expressed through text, capturing subtleties that often elude conventional analysis tools. One of BHAAVCHITRA's most distinctive features is its ability to adapt to the ever-changing nature of online communication. From decoding the latest internet slang to interpreting region-specific expressions, the system demonstrates remarkable flexibility. This adaptability ensures that BHAAVCHITRA remains relevant and effective in an environment where language and communication styles are in constant flux. The system's impact extends far beyond mere sentiment classification. By providing a more nuanced, context-aware interpretation of text-based sentiment, BHAAVCHITRA not only advances the field of sentiment analysis but also contributes to a more empathetic and understanding digital ecosystem. Its ability to unravel the complexities of human sentiment in text paves the way for more effective communication strategies, better-informed decision-making processes, and ultimately, a deeper understanding of the digital human experience.

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