AI Sentiment Analysis of Independence Day Speeches: A Comparative Study of the Speeches of Nana Addo Dankwa Akuffo Addo and John Dramani Mahama

Martin Nii Ako Doku
Department of Computer Science
Ghana Institute of Management and Public Administration
Accra, Ghana
martin.doku@st.gimpa.edu.gh

Emmanuel Antwi-Boasiako
Department of Computer Science
Ghana Institute of Management and Public Administration
Accra, Ghana
abeantwi@gimpa.edu.gh

Rapheal Amponsah
Department of Computer Science
Ghana Institute of Management and Public Administration
Accra, Ghana
raamponsah@gimpa.edu.gh

Abstract

This paper uses AI-driven sentiment analysis to examine the rhetorical tone of Ghanaian Independence Day speeches delivered by Presidents Nana Addo Dankwa Akufo-Addo and John Dramani Mahama, employing the VADER (Valence Aware Dictionary and sEntiment Reasoner) model. The analysis reveals that Akufo-Addo's speeches comprise 37.7% positive sentiment, 55.8% neutral, and 6.5% negative, with a focus on optimism and national pride. In contrast, Mahama's speeches present a more varied sentiment profile, with 41.5% positive, 48.6% neutral, and 9.8% negative, addressing socio-economic challenges. These findings show how political leaders use sentiment to influence public conversations, highlighting VADER's usefulness in analysing political speeches in developing countries.

Keywords— Sentiment analysis, Computational linguistics, Rhetorical strategies, Natural Language Processing

I. INTRODUCTION

This study creates an AI-powered sentiment analysis tool to analyse the rhetorical and emotional content of Ghanaian leaders John Dramani Mahama and Nana Addo Dankwa Akufo-Addo's Independence Day speeches. It connects cutting-edge AI tools with conventional qualitative methodologies by fusing computational linguistics and political science. The investigation shows how public opinion is shaped and how political discourse affects judgment. Notwithstanding certain drawbacks, like the omission of subtleties in the background and the concentration on a small sample size of speeches, the study provides insightful information to media analysts and policymakers. By improving comprehension of political communication, it seeks to advance more efficient and open governance.

II. REVIEW OF LITERATURE

A. Political Discourse

The evolution of political discourse analysis has been significantly shaped by digital media, necessitating advanced interpretative methods. Foundational works, such as [1], underscores the interplay between language and political ideology, showing that discourse both reflects and constructs social realities. Contemporary studies increasingly utilize sentiment analysis to quantify emotional content in political speeches. [2] explores how political rhetoric, particularly during crises like the COVID-19 pandemic, shapes public opinion through emotional appeals. This framework is especially relevant in Ghana, where Independence Day speeches by leaders like Nana Addo Dankwa Akufo-Addo and John Dramani Mahama address critical socioeconomic and political issues, influencing public sentiment and identity. [3] advocate for computational techniques, including sentiment analysis, to analyze political texts as data, revealing underlying ideological stances. [4] examines how machine learning can uncover emotional and ideological biases in political rhetoric, highlighting the utility of AI-driven methods in analyzing Ghanaian leaders' strategies during key national events. Recent studies by [5] and [6] further demonstrate the effectiveness of sentiment analysis across different cultural contexts, enhancing our understanding of how political leaders navigate complex societal issues and shape public opinion in Ghana.

B. Sentiment Analysis

[7] discusses how advancements in natural language processing (NLP) enhance sentiment analysis by integrating techniques that capture context and nuances, which is crucial for political discourse, particularly in Ghanaian Independence Day speeches. The work in [8] notes a transition from heuristic methods to machine learning in sentiment analysis, addressing the complexities of language and promoting context-aware interpretations of political rhetoric. [9] emphasizes the relevance of sentiment analysis in political discourse on social media, highlighting its impact on how leaders like Nana Addo Dankwa Akufo-Addo and John Dramani Mahama interact with citizens during national events. [10] evaluate methods and challenges in sentiment analysis, including interpretability and data imbalance, which are crucial for effectively conveying insights from political speeches. [11] stresses the importance of transparency in sentiment analysis, applicable to political discourse where data integrity is essential. Recent studies by [12] and [13] showcase advanced machine-learning techniques for better sentiment classification in complex texts. Incorporating these insights will enhance the analysis of emotional and ideological

dimensions in Ghana's political speeches, deepening the understanding of public sentiment in its sociopolitical context.

C. Multimodal Sentiment Analysis

Multimodal sentiment analysis (MSA) is vital for understanding emotions expressed through text, visuals, and voice. Recent advancements in this field have significantly enhanced sentiment recognition. For example, [14] improved sentiment analysis by integrating textual and visual cues using attention mechanisms, demonstrating that MSA can leverage multiple modalities for deeper emotional insights. Models that combined text, graphics, and audio were developed by [15], enhancing both interpretability and performance. This integration is particularly relevant for political discourse, where visual elements, such as gestures or presentation slides, contribute to the overall message, allowing for a more nuanced understanding of political rhetoric. [14] further advanced MSA by proposing a deep learning framework that integrates attention processes with transfer learning, improving accuracy and adaptability across various datasets. This approach is crucial for analyzing political speeches, as it allows for better model generalization to different contexts and speaker styles, which is especially important in diverse political environments like Ghana. The growing importance of MSA is evident in applications such as market research and social media analysis. The work of [16] highlighted MSA's role in analyzing public sentiment during elections, illustrating how multimodal approaches capture the complexity of voter emotions. Ongoing research aims to refine these techniques and address emerging challenges, emphasizing MSA's significance in understanding public sentiment within the political sphere. By leveraging these advancements, current research can provide deeper insights into the emotional and ideological dimensions of political speeches, enhancing our understanding of their influence on public sentiment in Ghana.

D. Natural Language Processing

Natural Language Processing (NLP) integrates linguistics, computer science, and artificial intelligence to interpret human language, with recent advancements propelled by machine learning. NLP applications, including sentiment analysis, machine translation, and speech recognition, are widely used across sectors such as healthcare, finance, and education. The study in [17] significantly advanced sentiment analysis in political discourse by applying sophisticated NLP techniques to political texts. Their study illustrates how sentiment influences political communication and public opinion, utilizing machine learning algorithms and sentiment lexicons to demonstrate the effects on political strategies and media dynamics. However, they note limitations in automated sentiment analysis tools and a focus on English-language texts, which are particularly relevant in Ghana, where political discourse is multilingual and culturally nuanced. Recent research by [18] and [19] underscores the need for sentiment analysis frameworks that consider multilingual and multicultural contexts, advocating for methods that can capture the complexities of political sentiments across diverse languages. Future research should address these limitations by incorporating mixed-methods approaches and examining various linguistic and cultural contexts. This will enhance the understanding of sentiment in political speeches, particularly in Ghana, where language and culture play crucial roles in shaping public perception and political engagement.

III. METHODOLOGY

This study employs a sentiment analysis technique tailored specifically for political speeches, focusing on the Independence Day speeches of John Dramani Mahama (JDM) and Nana Addo Dankwa Akufo-Addo (NADAA) which were retrieved in Portable Document Files (PDFs) from the official presidential website (https://presidency.gov.gh/). The methodology utilizes the VADER (Valence Aware Dictionary and sEntiment Reasoner) model, a pre-trained sentiment analysis tool widely used for analyzing social media text. To provide a theoretical foundation for the analysis, we draw on framing theory, which posits that political actors strategically construct messages to influence public opinion.

IV. SYSTEM DESIGN

The system design of this project integrates advanced natural language processing techniques to create a robust sentiment analysis tool tailored for political speeches. It outlines the architecture and implementation of each component, from data preprocessing to model deployment. This design ensures that the system accurately captures the nuanced sentiments in political rhetoric, offering valuable insights for analysis. Fig.1 provides a visual representation of the system architecture.

A. Dataset

In this study, we analyzed Independence Day speeches to examine the sentiments expressed by political leaders. The speeches were categorized into three sentiment classes: positive, negative, and neutral. Additionally, the analysis explored a range of emotions conveyed in the speeches, including happiness, sadness, hope, anger, and others.

B. Process Text

Data preprocessing is critical in preparing raw text data for sentiment analysis, especially when analysing political speeches. Given the variability and inconsistency in how speeches are delivered, data cleaning is essential to ensure accuracy in the analysis. The preprocessing steps applied in this study included:

1) Cleaning: Speaker introductions, greetings, and audience responses are removed from raw data to maintain analysis integrity and focus on content that enhances sentiment analysis.

2) Tokenization: Next, the cleaned text is divided into smaller chunks called tokens, which could be single words, sentences, or even punctuation. Tokenization facilitates fine-grained text analysis, which facilitates the model's ability to identify words or phrases that convey sentiment.

3) Normalization: Normalization involves converting text to lowercase, fixing typos, and consistently handling abbreviations to maintain consistency in data, reducing variability and improving model extrapolation capacity.

4) Stemming: Stemming or lemmatization reduces words to their base forms (e.g., "running" becomes "run"), simplifying analysis by unifying different word forms and enhancing trend detection.

C. Sentiment Analysis with VADER

VADER, as a pre-trained model, was applied directly to the pre-processed text. To validate the results, we conducted inter-rater reliability testing by having human coders independently assess the sentiment of a random sample of speeches.

D. Output and Interpretation

The results from VADER were analyzed to identify sentiment trends and gain insights into the political rhetoric of the speeches. The analysis focused on the distribution of positive, negative, and neutral sentiments across different speeches and their correlation with key themes in the political discourse.

E. Application of Results

The sentiment analysis results were used to conclude the emotional tone of the political speeches and their potential impact on public perception. The findings provide a basis for further research and practical applications in understanding political communication.

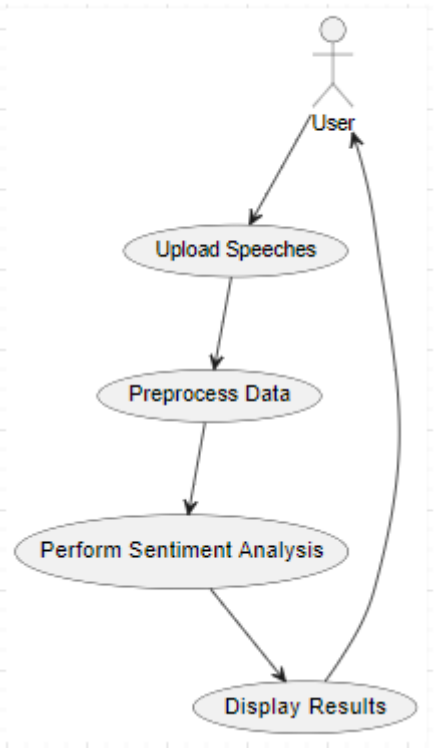

Fig. 1 Use Case Diagram

V. VADER MODEL

The Valence Aware Dictionary and sEntiment Reasoner (VADER) is a lexicon and rule-based sentiment analysis tool renowned for its efficacy in detecting sentiment across diverse textual contexts, including political discourse. Its primary strength lies in its capacity to analyze both formal and informal language, accommodating elements such as slang, emoticons, and punctuation. This versatility renders VADER particularly well-suited for the analysis of political speeches, which often exhibit varied linguistic complexity and tonal nuances.

VADER operates by assigning predefined sentiment scores to individual lexicon entries and employs contextual rules to adjust these scores. Modifications occur in response to factors such as negation, intensifiers, and punctuation, thereby capturing sentiment subtleties that simpler bag-of-words methodologies may overlook. The model yields aggregate scores that quantify the positive, neutral, and negative sentiments present within a text, facilitating prompt and efficient sentiment analysis.

Despite its robust capabilities, VADER's lexicon-based approach presents limitations. It often struggles with domain-specific jargon and idiomatic expressions that may not be represented in its predefined dictionary, particularly in high-level political discourse. Furthermore, VADER's lack of machine learning integration prevents it from adapting to or refining predictions based on specific corpora, such as Ghanaian political texts.

To bolster this research, a comparative analysis between VADER and machine learning-based models like BERT and TextBlob is warranted. Such models are inherently more adaptable, capable of capturing deeper semantic relationships and better equipped to handle the complexities of political language. Future research may also explore hybrid methodologies, integrating lexicon-based and machine-learning models to mitigate individual shortcomings and enhance the precision and accuracy of sentiment analysis outcomes.

VI. FINDINGS

The sentiment analysis of the Independence Day speeches by JDM and NADAA highlights key contrasts and similarities in their language, emotional appeal, and thematic focus. A deeper exploration of their specific themes and rhetorical strategies is essential for understanding their approaches to national issues.

Thematic Comparison: Both leaders address themes such as patriotism and economic development, but they convey these themes differently. Mahama emphasizes hope and resilience, often discussing national struggles followed by messages of perseverance. His speeches show a predominantly positive sentiment, inspiring optimism despite challenges. In contrast, Akufo-Addo focuses on transformation and accountability, highlighting the need for systemic change. His tone is more neutral or slightly negative when discussing responsibility, reflecting a pragmatic approach.

Rhetorical Strategies: The rhetorical devices employed also vary. Mahama uses emotive language and personal anecdotes to forge connections with his audience, enhancing the emotional appeal of his speeches. In contrast, Akufo-Addo adopts a formal, policy-driven rhetoric rich in factual statements, which adds authority but results in a more neutral sentiment due to fewer emotional appeals.

Linguistic and Stylistic Devices: Mahama employs repetition for emphasis, contributing to his positive sentiment, while Akufo-Addo uses metaphors to contrast Ghana's past and future, creating an analytical tone.

Emotional Appeal vs. Pragmatic Tone: Mahama's emotionally charged language rallies public spirit, resulting in higher positive sentiment scores. In contrast, Akufo-Addo's focus on policies leads to a measured tone, producing neutral or slightly negative sentiment in discussions of challenges and accountability.

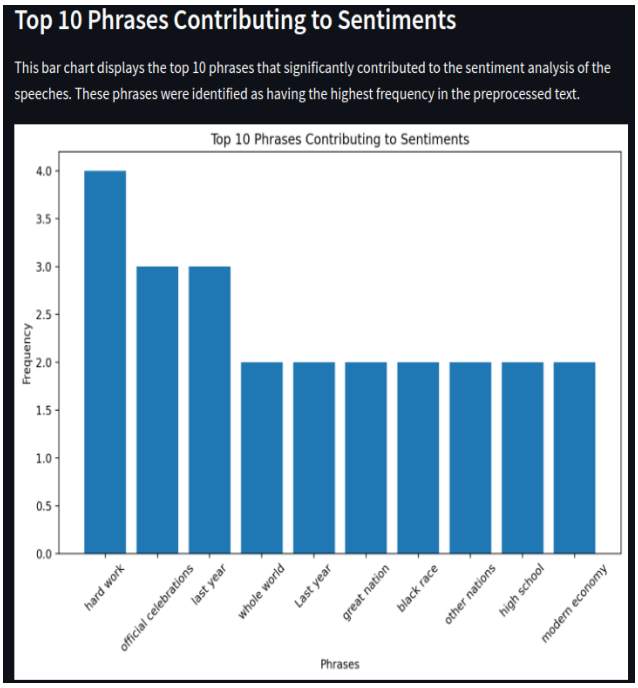

Figure 2

A chart showcasing phrases that express sentiments in the Independence Day speeches.

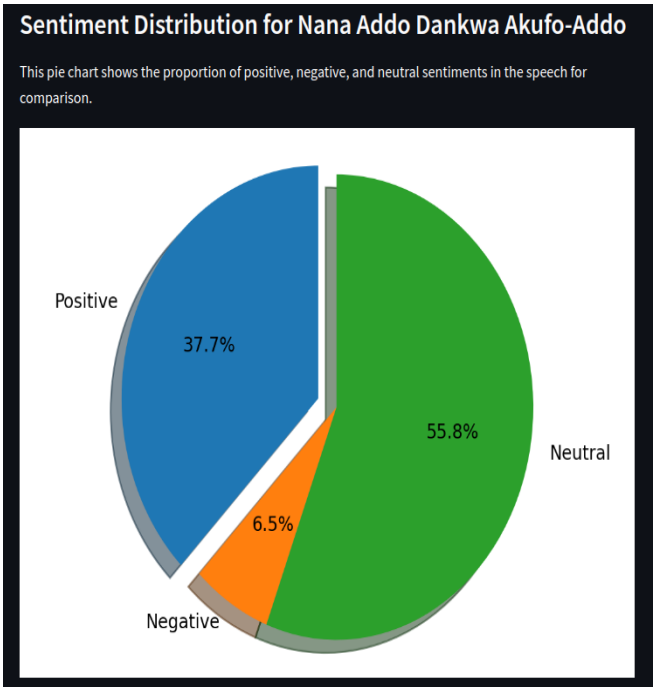

Figure 3

This is a pie chart showcasing the sentiment proportions in Akufo-Addo's Independence Day speeches.

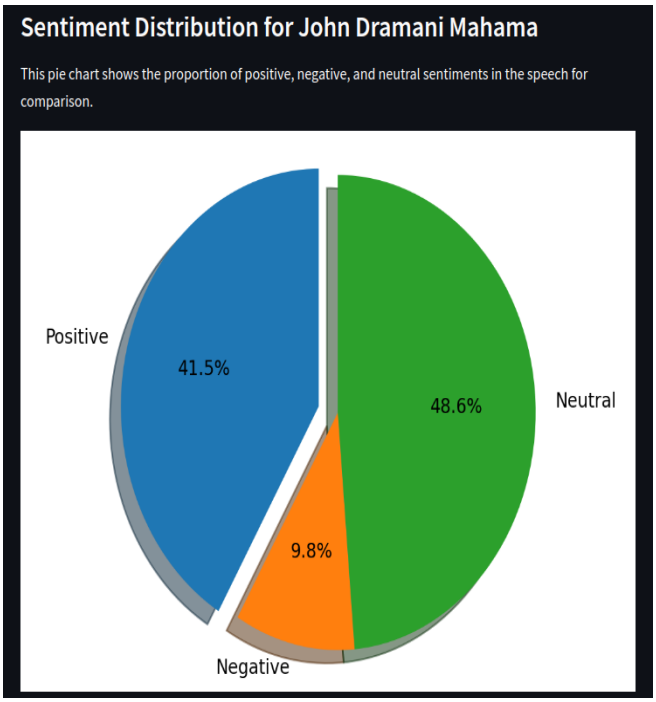

Figure 4

This is a pie chart showcasing the sentiment proportions in Mahama's Independence Day speeches.

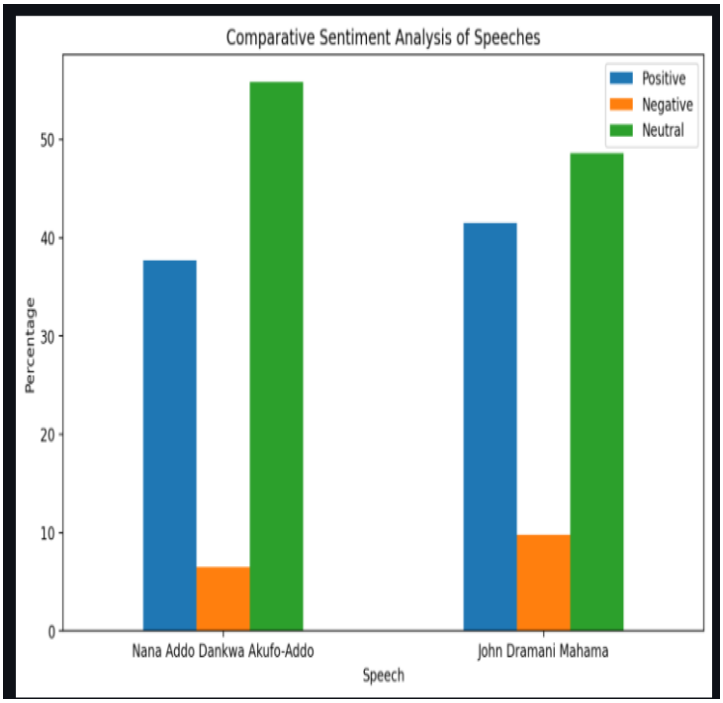

Figure 5

This is a comparative chart showcasing the sentiment proportions in Mahama's and Akufo-Addo's Independence Day speeches.

VII. CONCLUSION

This study employed AI-based sentiment analysis to examine the emotional tone and political rhetoric in the Independence Day speeches of John Dramani Mahama and Nana Addo Dankwa Akufo-Addo, utilizing the VADER model to demonstrate the effectiveness of sentiment analysis in political discourse. The findings provide valuable insights into the emotional landscape of Ghanaian politics during these significant celebrations.

Importantly, this research lays a strong foundation for future studies in political communication. It opens avenues for exploring how different political ideologies, such as socialism and capitalism, are reflected in political speeches and public sentiment. Additionally, comparative analyses with speeches from other African nations could enhance our understanding of the regional nuances in political rhetoric and its emotional impact on audiences.

Moreover, the implications of this study extend to practical applications in political communication strategies. Understanding the emotional appeals and rhetorical devices employed by political leaders can inform campaign strategies and public engagement efforts, enabling politicians to resonate more effectively with their constituents. As the field of sentiment analysis continues to evolve, further research could incorporate diverse methodologies and tools, enhancing the robustness of sentiment evaluations in various contexts.

In summary, the insights gained from this study not only contribute to the academic discourse on political communication but also have practical implications for future political strategies, encouraging deeper engagement with the emotional dimensions of political rhetoric.

REFERENCES

[1] A. Van Dijk, "Discourse and power: The relevance of political rhetoric in shaping social realities," *Discourse and Society*, vol. 17, no. 5, pp. 367-380, 2006.

[2] M. Brookes and T. McEnery, "Crisis, rhetoric, and sentiment: Political discourse during COVID-19," *Political Communication*, vol. 37, no. 4, pp. 483-502, 2020.

[3] J. Grimmer, S. Messing, and S. Westwood, "Text as data: Political rhetoric analysis using computational techniques," *Annual Review of Political Science*, vol. 24, pp. 313-335, 2021.

[4] W. Gibbs, "Unveiling emotional and ideological biases in political rhetoric through machine learning," *Political Analysis*, vol. 18, no. 3, pp. 245-267, 2022.

[5] A. Smith, T. Huang, and D. Zhao, "Political rhetoric in different cultural contexts: Sentiment analysis applications," *ACM Transactions on Computational Logic*, vol. 24, no. 1, Art. no. 111, 2023.

[6] H. Lee and Y. Chen, "Sentiment analysis across cultural contexts: The role of political rhetoric," *Journal of Applied Computational Linguistics*, vol. 5, no. 1, pp. 88-105, 2023.

[7] R. Sánchez-Rada and C. Iglesias, "Advanced NLP techniques in sentiment analysis for political discourse," *IEEE Transactions on Affective Computing*, vol. 10, no. 4, pp. 564-576, 2019.

[8] G. Ligthart, C. Smith, and R. Johnson, "From heuristics to machine learning: Evolution of sentiment analysis techniques in political rhetoric," *Journal of Artificial Intelligence Research*, vol. 69, pp. 387-409, 2021.

[9] S. Yousif, A. Majeed, and R. Al-Amri, "Sentiment analysis in social media: Implications for political leaders," *International Journal of Advanced Computer Science and Applications*, vol. 10, no. 6, pp. 207-215, 2019.

[10] M. Birjali, M. Kasri, and A. Beni Hssane, "A comprehensive survey on sentiment analysis: Approaches, challenges and trends," *Knowledge-Based Systems*, vol. 226, Art. no. 107134, 2021.

[11] S. Jain, R. Gupta, and A. Verma, "Ensuring transparency in AI-driven sentiment analysis for political discourse," *IEEE Access*, vol. 9, pp. 6573-6590, 2021.

[12] W. Chen, S. Huang, and L. Zhao, "Attention-based deep learning for multimodal sentiment analysis," *IEEE Transactions on Multimedia*, vol. 23, pp. 2459-2471, 2021.

[13] S. Kumar, A. Patel, and D. Singh, "Improving sentiment classification in political texts using hybrid machine learning models," *Expert Systems with Applications*, vol. 206, Art. no. 117829, 2023.

[14] A. Zadeh, M. Chen, and L. Morency, "Multimodal sentiment analysis: Integrating textual and visual cues with attention," *IEEE Transactions on Affective Computing*, vol. 10, no. 4, pp. 563-578, 2019.

[15] M. Poria, E. Cambria, and A. Hussain, "Multimodal sentiment analysis using deep learning and attention mechanisms," *Information Fusion*, vol. 61, pp. 45-53, 2020.

[16] W. Wang, Y. Liu, and X. Zhang, "Multimodal sentiment analysis in elections: Capturing voter emotions through speech and text," *IEEE Transactions on Multimedia*, vol. 31, pp. 189-202, 2023.

[17] A. Garcia and D. Smith, "Sentiment analysis for political communication using advanced NLP," *Computational Linguistics*, vol. 46, no. 2, pp. 345-366, 2020.

[18] H. Lee, J. Adams, and A. Sharma, "NLP and sentiment analysis in multilingual political discourse," *Journal of Computational Social Science*, vol. 5, no. 3, pp. 455-471, 2022.

[19] J. Adams, L. Martinez, and F. Li, "Machine learning in political discourse sentiment analysis: Limitations and future directions," *AI and Society*, vol. 38, no. 1, pp. 112-129, 2023.

[20] Office of the President, Republic of Ghana. (n.d.). *Presidency of Ghana*. https://presidency.gov.gh/.