

Twitter Sentiment Analysis of Lagos State 2023 Gubernatorial Election Using BERT

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ARTICLE INFO

Keywords:

NLP,
NLU,
Twitter,
sentiment analysis,
opinion mining,
Nigeria,
election,
machine learning,
BERT,
LSTM,
SVM

ABSTRACT

Many cutting-edge language models have been used in the past to forecast election results. Sentiment analysis aids in opinion mining – a common experiment used to detect public opinions – on a given topic. Twitter has gained popularity and established itself as a crucial instrument for analyzing public opinion on elections and other trending issues. The unexpected but interesting results of recently held Nigeria's presidential election shifted attention to the upcoming governorship race in Lagos State. In this work, we propose a Google's Bidirectional Encoder Representations from Transformers (BERT) model for the sentiment analysis of governorship election in Lagos State, Nigeria, using Twitter data. A total of 800,000 personal and public tweets were scraped from twitter concerning the three prominent contesting Lagos State Gubernatorial candidates using carefully selected search queries. The tweets were preprocessed to avoid noise and inconsistencies and the preprocessed tweets were parsed into the pre-trained and finetuned BERT model. The result was analyzed to establish the sentiments of the public about the candidates. The social networks of the candidates were also presented and the effect of parameter using different learning rates (LR) was also considered. The BERT model achieved the maximum performance under varied learning rate and epoch sizes of 88% precision, 92% recall and 91% F1-Measure. Results also showed that the learning rate at $1e-7$ gave the best performance. Also, the smaller the learning rate, the higher the accuracy but the larger the epoch size, the higher the accuracy. Applying the developed BERT model to the public's tweet showed that the election will be a two-party race between the Labour Party and All Progressives Congress party, thereby challenging the status quo. The results of the experiment demonstrated that sentiment analysis and other Natural Language Processing activities can help with comprehension of the social media environment. Results also showed how much influence each candidate has over the outcome of the election. We come to the conclusion that estimating election results and providing insights for electoral parties can benefit from sentiment analysis and other language models.

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Cite this article as:

Wusu, A., Olabanjo, O., Padonu, R., Afisi, O., & Mazzara, M. (2023). Twitter Sentiment Analysis of Lagos State 2023 Gubernatorial Election Using BERT. *Journal of Advanced Research in Social Sciences*, 6(2): 59-75. <https://doi.org/10.33422/jarss.v6i2.1027>

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1. Introduction

Sentiment analysis models, using public political discourse, have gained a wide popularity in the field of political methodology (Roberts, 2018); an approach for the study of quantitative and qualitative approaches used to understand politics and political systems (Achen, 2002). Several studies have presented methods which often combine statistics, mathematics and formal theory for the understanding of politics. In the past, election outcomes have typically been anticipated using analytical and statistical prediction techniques, with the methodology relying on surveys and qualitative methodologies, and studying political party manifestos while keeping an eye on trends in the mainstream media (Ascher, 1982; Remmer, 1993). It has become increasingly challenging yet interesting to anticipate elections due to greater competition and opposition in the government, especially in countries with multi-party systems like Nigeria (Cameron, Barrett, & Stewardson, 2016; Oluro & Bamigbose, 2021). The history of election forecasting goes back in time with a number of reasons such as aiding politicians to adapt their strategy/ideas, helping scientists to improve their forecasting models, assisting media to inform readers/viewers, and satisfying the curiosity of citizens among other things (Sanders, 2023).

Before and after the social media revolution, surveys have been used frequently to identify opinions prior to elections; however, this approach has been limited by the difficulty in constructing an appropriate sampling procedure, hence making it difficult to obtain a representative sample of political viewpoints. Social media platforms such as Twitter, Facebook, Reddit and Instagram have helped in some way to overcome the “systematically inappropriate” sampling procedure in survey studies and have been the prominent tools of political campaigns and activism during elections. The recent advancements in the fields of Natural Language Understanding (NLU) and Natural Language Processing (NLP) have improved the reliability of prediction models built for unstructured and unsupervised dataset. The social media has radically upended the traditional campaign norms and tactics in national elections vis-à-vis its volume, velocity, scope and tactics of use (Allcott & Gentzkow, 2017; Hendricks & Schill, 2017). Studies also showed that even if it cannot be categorically said that social media singlehandedly elected Donald Trump, his social media campaign strategies changed the way social media will be used in elections in the future (Hendricks & Schill, 2017; Wani & Alone, 2014). Specifically, users of Twitter commonly seek information to digest or disseminate. Being a unique platform where trends are easily formed around topics via generation of hashtags as against individual posts which is prominent across other social media outlets. It is therefore easier to track users’ moods and directions as regards selected topics. Advertently, in a study to examine the potential of Twittersphere, authors found that out of all sampled categories, political hashtags and therefore discussions were the most persistent on Twitter (Kwak, Lee, Park, & Moon, 2010).

There has been a growing interest in the use of NLP and other artificial intelligence techniques to predict election results in recent years with the numerous amount of social media datasets generated daily. These techniques include sentiment analysis and topic modeling in addition to more advanced models that incorporate deep learning and fundamental statistical techniques. Two important aspects of NLP are sentiment analysis and opinion mining, which aid in classifying and investigating the behavior and approach of social media users with regards to brands, events, companies, customer services as well as elections. There are algorithms for automating the process of extracting emotions from user’s posts by processing unstructured texts and preparing models that extract knowledge from it. In this study, we consider Twitter; one of the prominent social network sites, to analyze the upcoming 2023 Lagos State Gubernatorial election. Given the statistics, Twitter has an active monthly user of 316 million and, on average, about 500 million tweets are posted daily. A review of related works in

subsequent section shows that Twitter is one of the most powerful tools in political analysis. In the current fast-paced global network system, information spreads digitally between users and shapes the way these users feel about an event, thereby making it crucial to understand the thought polarity, emotions and sentiment of the masses.

This study was conducted to understand opinions on 2023 Lagos State gubernatorial election using Twitter dataset. It aims to capture, process and evaluate the public opinions from three main perspectives: sentiment and timeline analysis of the personal accounts of contesting candidates; sentiment and general tweet analysis of the public on the three candidates and general tweet analysis of the public on the Lagos State 2023 elections without reference to any of the candidates. The study would therefore concentrate on the following methodology:

- i. Identifying keywords, hashtags and accounts which wholistically explain the subject matter as well as capture the top three contestants for Lagos State 2023 gubernatorial elections.
- ii. Scraping the tweets through Twitter API using Python programming.
- iii. Data cleaning (removing white spaces, links, punctuations, stop words, tokenization, retweet).
- iv. Developing, pretraining and tuning a BERT model and training with existing annotated IMDB dataset.
- v. Using Natural Language Understanding techniques such as sentence polarity, topic modeling, entity extraction, word frequency, word cloud etc. to understand the personal profiles of the three strongest Lagos gubernatorial candidates.
- vi. Analyzing the result to predict the direction of Lagos State election to be conducted on March 18, 2023.

2. Study Premise

Lagos State happens to be the smallest of the thirty-six states in Nigeria, Federal Capital Territory inclusive, but with the highest urban population consisting 27.4% of the National population. Lagos is Africa's leading New Partnership for Africa's Development (NEPAD) city and world's sixth megacity which attained its megacity status in 1995. It is essentially a Yoruba environment but with diverse culture and traditions and inhabited by the Yorubas, Aworis and the Ogus, with other pioneer immigrant settlers (Edos, Saros, Brazilians, Kannike/Tapa) collectively called Lagosians but also referred to as the Ekos. Due to its strong economic foundation, maritime location, and socio-political significance which led to a high rate of migration to the State, Lagos has earned the title of megacity.

Politically, Lagos State consists of 20 Local Government Areas (LGAs) and 37 Local Council Development Areas (LCDAs). The prominent ruling political party in Lagos is the All Progressives Congress (APC) which is one of the three major ruling parties in Nigeria, alongside People's Democratic Party (PDP) and Labour Party (LP). Unlike in the past where the Presidential election results were dominated by APC and PDP only, the Presidential election which held on the 25th February, 2023 was keenly contested by three political parties with the winning distribution shown in Figure 1. This is as rightly predicted by authors in previous study (Olabanjo et al., 2022).

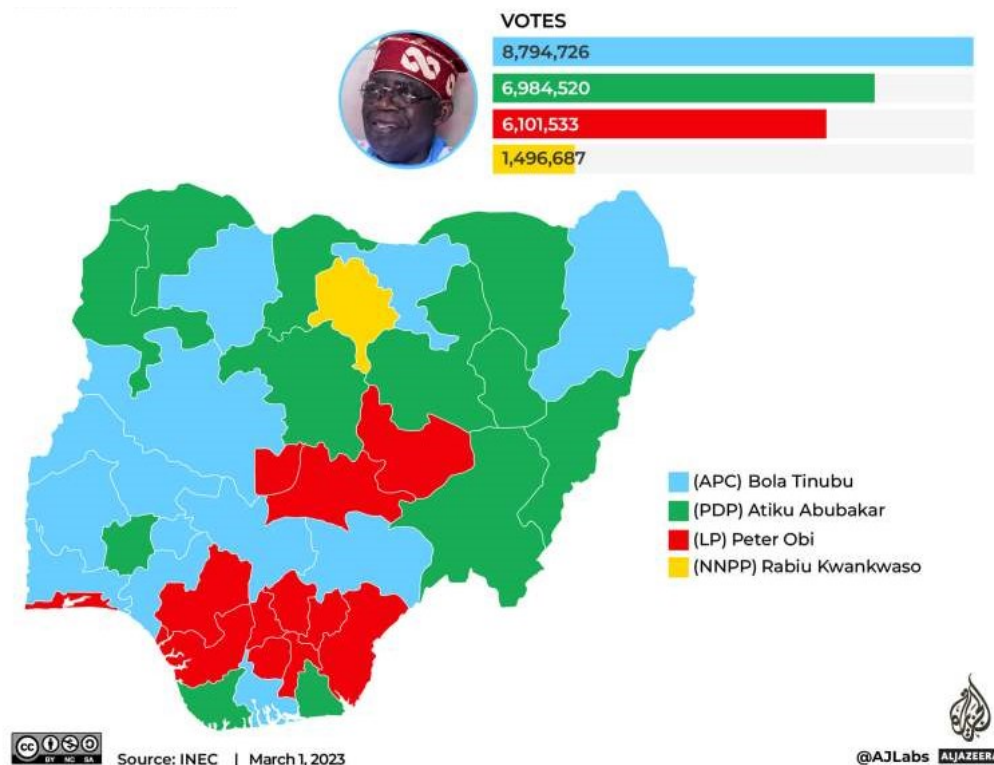


Figure 1. Geographical Distribution of Candidate's Wins by States (image adopted from AlJazeera)

After the Independent National Electoral Commission (INEC) – the election conducting body – announced the results of Presidential election, there have been allegations of rigging, misconducts and misappropriation in the electoral process, improper conducts, unacceptable result transmission from polling booths, amongst others, thereby electrifying the Twitter space. This agitation, with the fact that the 2023 winner party APC did not win Lagos, brings a major paradigm shift from the status-quo of the APC party always winning Lagos State gubernatorial seat. This implies that the result of the forthcoming governorship election in Lagos State will be as interestingly dicey as the Presidential election; hence, the justification for this study.

3. Related Works

Sentiment analysis has been used to predict the opinions of the citizens on US election using Twitter data (Wang, Can, Kazemzadeh, Bar, & Narayanan, 2012). The authors used 17,000 tweets to train their model (Naive Bayes), and by categorizing the tweets into positive, negative, neutral, and not-sure, the model was able to predict outcomes, however, with less than 60% accuracy. This helped in the analysis of real-time tweets from the people, which provided invaluable insights into the public's perceptions of each candidate. Another study (Neogi, Garg, Mishra, & Dwivedi, 2021) scraped over 20,000 tweets from Twitter to analyze and categorize them as favorable, negative, or neutral in order to get international perspectives regarding a farmer protest which took place in India. Both TF-IDF and Bag of Words were employed in the analysis, however Bag of Words performed better than TF-IDF. Other authors (Chandra & Saini, 2021; Somula, Dinesh Kumar, Aravindharamanan, & Govinda, 2020) also established that Twitter can be used as an election indicator and has the ability to predict the favorite candidate of the people to emerge as the winner before the election is conducted. The people gave positive opinions about Donald Trump in almost all states in the United States prior to election. 1,000,000 tweets were collected from various users from different states and sentiment analysis was conducted. A study (Kausar, Soosaimanickam,

Nasar, & Applications, 2021) used Twitter data to check and conduct how different countries affected by the Corona virus coped with the situations. Tweets posted in English were analyzed to give the opinion and emotion of the people concerning the pandemic in their respective countries and 50,000 tweets were used in the study. Studies have also combined different features and used ensemble models to increase the detection of polarity of tweets for sentiment analysis and established that unsupervised and ensemble machine learning models outperformed other classical machine learning models in detecting opinions from text (Bibi et al., 2022; Carvalho & Plastino, 2021). Authors have used Twitter data to examine political homophily in American Presidential Elections in 2016 where 4.6 million tweets were collected for analysis (Caetano, Lima, Santos, Marques-Neto, & applications, 2018).

In some studies, authors used the ratio of positive message rate and negative message rate to predict the likely winner of a forthcoming election using twitter data and it showed that these opinions could be used to predict candidate that will emerge as the winner (Yavari, Hassanpour, Rahimpour Cami, & Mahdavi, 2022). Twitter data has been used to establish that social media is not only used to express opinions, but it is also used to share ideas and opinions among other users. Authors used 100,000 tweets to predict German federal election in 2009 which could serve as a political indicator for the election (Tumasjan, Sprenger, Sandner, & Welpe, 2010) and another study (Schmidt et al., 2022) also predicted the outcome of German presidential election of 2021 using 58,000 tweets which they established that traditional machine learning methods like Naive Bayes performed less than transformer-based models like the bidirectional encoder from transformers (BERT).

Authors (Razzaq, Qamar, & Bilal, 2014) performed social media sentiments about political parties to study and forecast Pakistan's general election. They used supervised machine learning algorithms to classify tweets into positive, negative, and neutral. The findings of their experiment shows that social media content can be a useful indication for identifying political behavior of various parties. In another study (Singh, Sawhney, & Kahlon, 2017), 90154 tweets were analyzed and the results were compared with the actual election results, their model predicted the winning party accurately. Twitter is indeed used as a platform for political deliberation. The political preferences shown via basic tweets comes close to traditional election polls. Simply, the number of tweets collected per party reflects the votes they receive in the election. Therefore, it's concluded that Twitter can be considered a good indication of real-time political sentiment (Tumasjan, Sprenger, Sandner, & Welpe, 2011).

4. Materials and Methods

This study seeks to analyze tweets of the political discourse around the upcoming 2023 Gubernatorial election in Lagos State and its prominent contesting candidates and this section describes in detail the approach used in discovering the sentiments of people around this area of public interest. Figure 2 shows the workflow of the BERT framework designed for this study. Every tweet with a political content either contains a neutral, positive or negative sentiment for or against a party or candidate. The sentiments contained in tweets especially when it is specific to a candidate is not easy to compute with algorithms since emotion expression varies with the personality, region and cultural background of each person. Since this is an unstructured (unlabelled) dataset, sentiment analysis is often challenging because of the features, context and semantics peculiarity of each tweet.

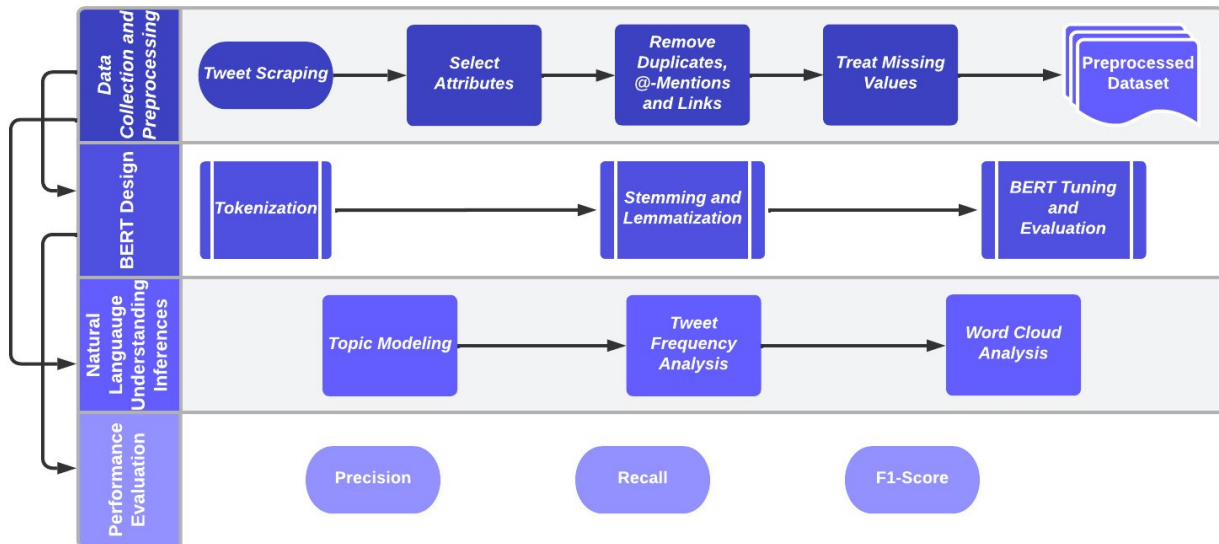


Figure 2. BERT Sentiment Analysis Framework

The study framework has been stratified into four phases namely: the data collection and preprocessing phase, the BERT design phase, the Natural Language Understanding Inference (NLUI) phase and the performance evaluation phase.

- a. *Data Collection and Preprocessing Stage:* This phase is concerned with the systematic extraction of relevant tweets from Twitter databases concerning Lagos State gubernatorial election. Two categories of dataset were extracted from Twitter using the Python snsrape library: personal tweets of three most prominent candidates in Lagos election race and the public tweets showing the interest of the potential voters in each of these candidates. After scraping, only the attributes of interest were retained for the study. The preprocessing (Algorithm 1) was done to remove noisy, irrelevant and inconsistent contents from the dataset.

Algorithm 1. Preprocessing Tweets

Input: Twitter posts

Output: Clean, preprocessed, data with no noise

For each comment in the Twitter data file

Initialize temporary empty string processedTweet to store result of output.

1. Replace all URLs or https://links with the word 'URL' using regular expression methods and store the result in processedTweet.
2. Replace all '@username' with the word 'AT_USER' and store the result in processedTweet.
3. Filter All #Hashtags and RT from the comment and store the result in processedTweet.
4. Look for repetitions of two or more characters and replace with the character itself. Store result in processedTweet.
5. Filter all additional special characters (: n | [] ; : { } - + () < > ? ! @ # % *,) from the comment. Store result in processedTweet.
6. Remove the word 'URL' which was replaced in step 1 and store the result in processedTweet.
7. Remove the word 'AT_USER' which was replaced in step 1 and store the result in processedTweet.

Return processedTweet.

The output of this phase is a fully preprocessed dataset ready to be passed into the BERT model.

- b. *BERT Design Phase*: This involves the tokenization of the tweets, stemming and lemmatization and the BERT finetuning and evaluation. Tokenization is a term which describes separating a corpus into smallest, syntactically meaningful, units. It is a basic stage in text data modeling that helps in understanding the meaning of a text by looking at the order in which the words are used. Porter stemmers were used to remove the suffix to create stems and essentially return each word to their base forms(Jivani, 2011). This is then passed into the BERT pipeline (Figure 3) for sentiment analysis.

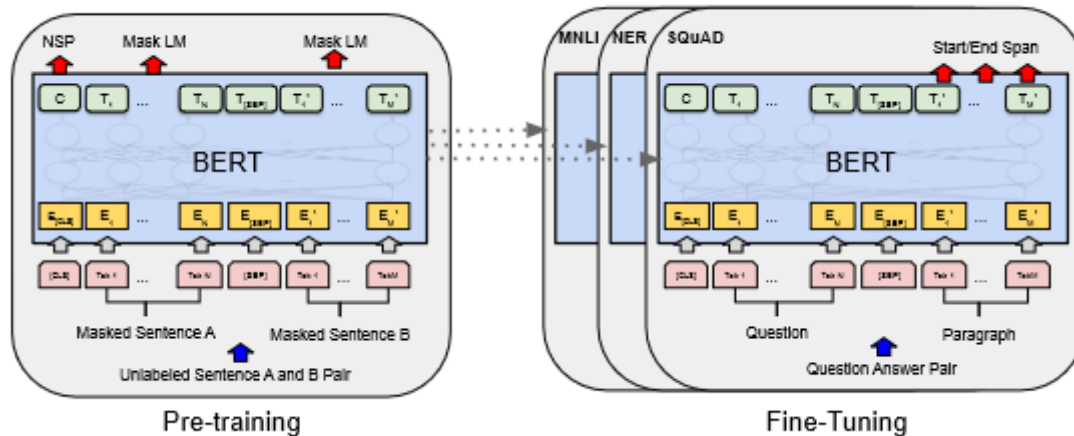


Figure 3. Overall pre-training and fine-tuning procedures for BERT(Devlin, Chang, Lee, & Toutanova, 2018).

Bidirectional Encoder Representations from Transformers (BERT) model is a Google AI Language masterpiece which has been widely applied in a wide range of NLP tasks(Devlin et al., 2018; Ravichandiran, 2021). The main strength of the BERT model is its application of bidirectional training of transformer which is a popular attention model to language modeling. Earlier similar models looked at text sequences from either a left-to-right or a combined left-to-right and right-to-left training perspective. BERT models have demonstrated that bidirectionally trained language models can comprehend context and flow of language more deeply than single-direction language models(Lee & Hsiang, 2020). The Linear Support Vector Classifier was used to test the accuracy of our deep models. SVM has been one of the most robust prediction techniques which is based on a statistical learning framework(Noble, 2006). Its workings and model development strategies have been broadly explained in some existing works(Pisner & Schnyer, 2020; Suthaharan, 2016; Widodo & Yang, 2007). The BERT pipeline as shown in Figure 3 has two main phases: the pre-training and the finetuning; the first concerned with the pretraining of unlabeled data while the second deals with modifying the learning parameters of the model. This is done until the optimum performance is achieved. BERT models use a multi-layer bidirectional transformer encoder with 6 layers in the encoder. For each word entered into the attention layer of the model, it is converted into Query (Q), Key (K) and Value (V) representing the actual word, keyword or meaning of the word and the value of the intent, purpose or polarity of the word respectively(Di Caro & Grella, 2013; Fan & Chang, 2010). The finetuning and evaluation process deals basically with the selection of hyperparameters and compares experimentally the results of training and testing. The major hyperparameters which require tuning in a BERT model are the learning rate, epoch and the batch size.

- c. Natural Language Understanding Phase: Three tasks are embedded in this phase to aid our understanding of the dataset being studied especially as it relates to the three contesting candidates under study. The time-series-frequency analysis was used to identify the tweet pattern and interest growth of voters regarding the candidates. Topic modeling is a technique for unsupervised categorization of twitter documents which helps to identify natural groups of words even when we are not certain what the outcome will be. In this study, the Latent Dirichlet Allocation (LDA), a particularly popular algorithm for achieving this task, was used (Wei & Croft, 2006; Yu & Yang, 2001). A n -dimensional Dirichlet random variable θ takes values in the $(k-1)$ -simplex, that is, a k -vector θ lies in the $k-1$ simplex *iff* $\theta_i \geq 0, \sum_{i=1}^k \theta_i = 1$ and has the probability density function on this simplex as given in Equation (1)

$$p(\theta|\alpha) = \frac{\Gamma(\sum_{i=1}^k \alpha_i)}{\prod_{i=1}^k \Gamma(\alpha_i)} \theta_1^{\{\alpha_1-1\}} \dots \theta_k^{\{\alpha_k-1\}} \quad (1)$$

where α is a k -vector with component $\alpha_i > 0$ and $\Gamma(x)$ is the Gamma function.

- d. Performance Evaluation: The sentiment models were assessed using recall, precision and F-measure as seen in Equations 3 - 5. Let TP_+ = true positive for all positive tweets, TP_- = true positive for all negative tweets, TP_ϕ = true positive for all neutral tweets. Then:

$$TPR, Sensitivity, Recall = \frac{\sum TP_+}{\sum \text{All Actual Positives}} \quad (2)$$

$$Precision = \frac{TP}{TP+FP} \quad (3)$$

$$F - Measure = \frac{2 * Precision * Recall}{Precision + Recall} \quad (4)$$

5. Results

In this section, we present and discuss the results obtained in this study with their implications for the set goals. Results are recorded in terms of the dataset, processing, parameter tuning, inferences and performance evaluation of the BERT sentiment model.

a. Dataset

Our dataset was extracted from immediately after the announcement of the Presidential election results (March 1, 2023) till two days before the gubernatorial elections. There is a keen interest of Twitter users in the Lagos State election, hence the vast number of tweets scraped for this study. Figure 4 shows the size of the dataset as it passed through each preprocessing task.

Figure 3 is a representation of the change in the size of dataset during each preprocessing task. The raw dataset was reduced from 302MB to 201MB after the preprocessing tasks were completed.

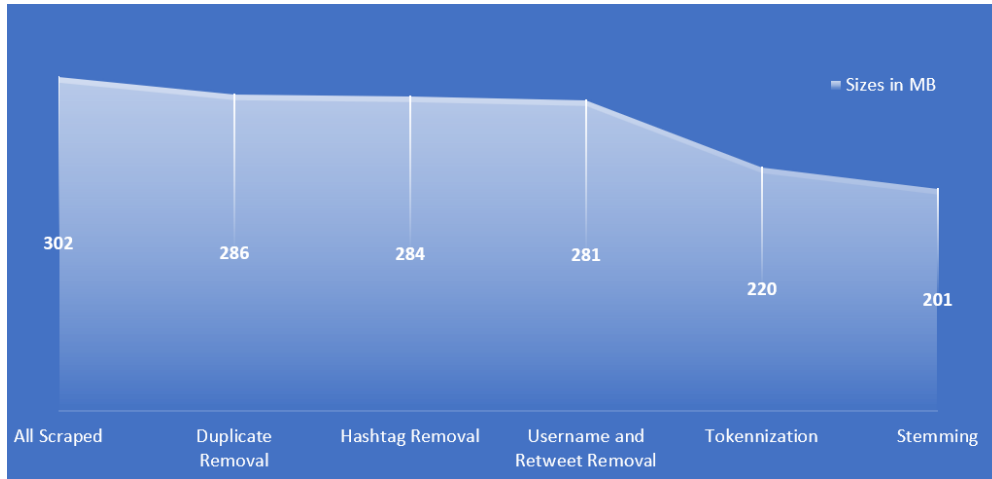


Figure 4. File size variation in Megabytes at each preprocessing task

b. Personal Tweet Analysis

In this section, we examined the personal Twitter accounts (@jidesanwoolu, @GRVLagos and @officialjandor) of each of the three Lagos Gubernatorial election candidates of interest from March 1, 2023 which happens to be the day attention shifted from the national election to the state election to March 17, 2023 (the eve of the state election). The first dataset contained the personal tweets of the candidates and Table 4 shows their tweet summarization, tweet frequency and impressions made by their personal tweets. The percentage total impression is given in Figure 6. Figure 5 shows the tweet counts of the respective candidates per day for the seventeen days study period. Results also show that Jandor has the least percentage total impressions (near zero), tweets and followers.

Table 1.

Personal tweet summaries of the Governorship Candidates from March 1st – March 17th 2023 excluding retweets and replies

	<i>Sanwoolu (APC)</i>	<i>GRVLagos(LP)</i>	<i>Jandor (PDP)</i>
Handles	@jidesanwoolu	@GRVLagos	@officialjandor
Total tweets	68	102	18
Retweets	40754	446963	987
Favorited	188907	1390358	3400
Replies	58634	49788	415
Quoted	233400	14537	101
Total followers	1908972	228521	13195

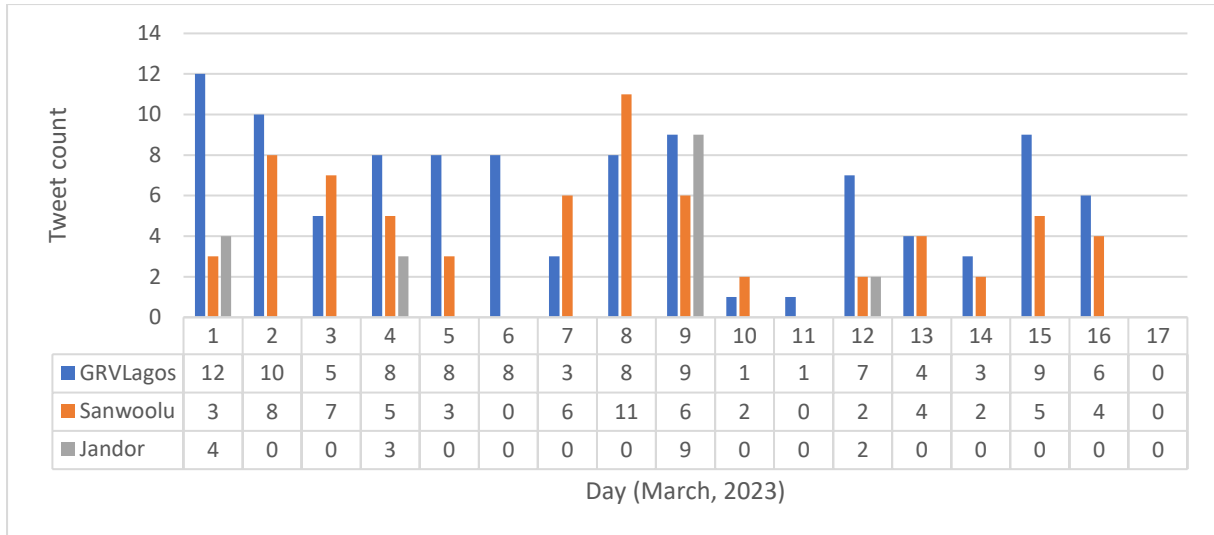


Figure 5. Daily tweet pattern of the three prominent Lagos State governorship candidates

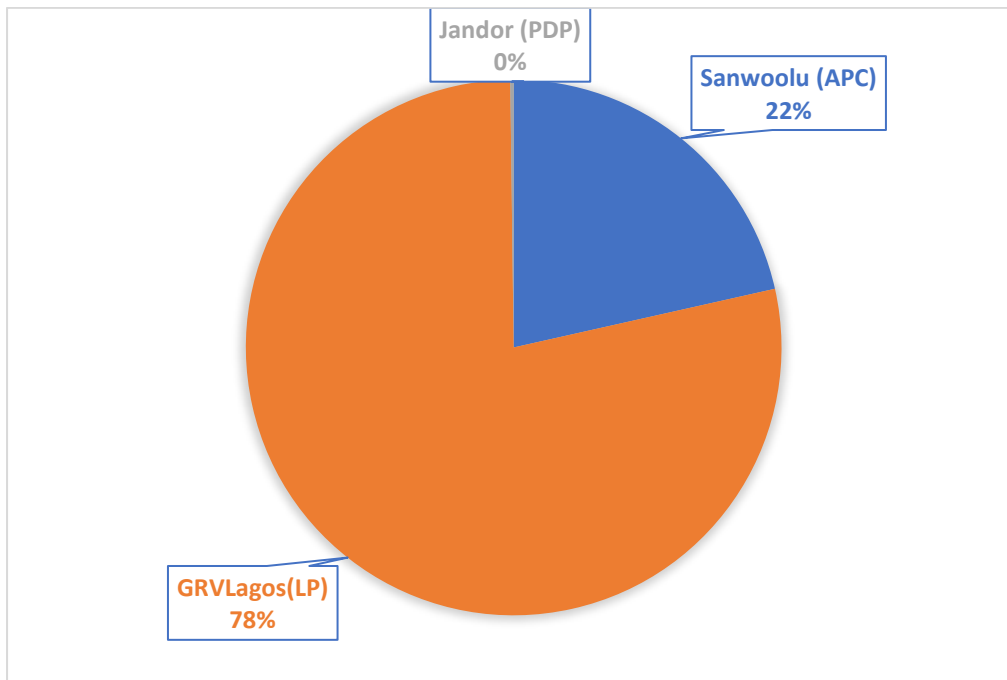


Figure 6. Total Impressions (Retweets + Replies + Quotes + Likes) of the three Lagos governorship candidates

c. Social Network Analysis

Our social network analysis on each of the three candidates for the period covered in this study produced Figure 7. This was used to understand the Twitter activities of the verified friends of the gubernatorial election candidates in terms of retweets and mentions. It shows that Sanwoolu maintained the strongest and most active verified network of Twitter friends relative to GRVLagos and Jandor. Jandor, on the other hand, has many friends who are dormant and inactive to his posts. Sanwoolu has prominently active verified friends including the President-elect, Bola Ahmed Tinubu, Babatunde Raji Fashola (minister for Works and Housing of Nigeria), etc.

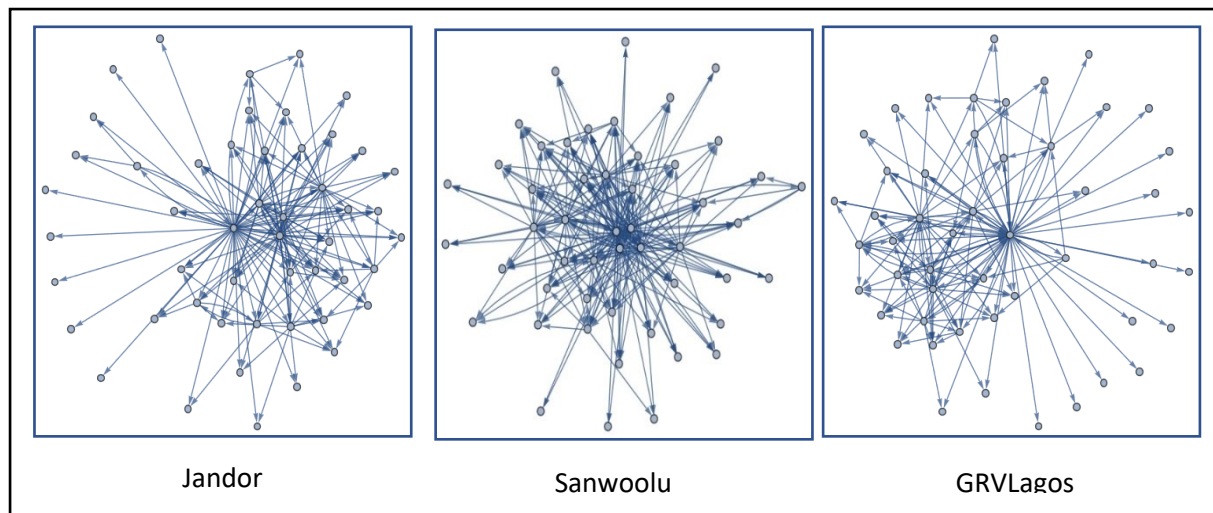


Figure 7. Social Network of the Lagos Governorship Candidates

d. Public Tweet Analysis

The BERT model was applied to the public tweets of the three candidates to determine the sentiments of the public concerning them. Tweets were categorized into Positive, Neutral and Negative represented by 1, 0 and -1 respectively. Table 2 presents the public tweets as scraped from Twitter. It shows that GRVLagos of the Labour Party amassed most public tweets and impressions. Figure 9 shows the sentiments of the tweet concerning the candidates as determined by the pretrained BERT model. This figure also shows that Jandor made the least total public impressions so far in this gubernatorial election contest. Also GRVLagos has made the most impression on Twitter with the highest tweets and highest overall public positive sentiments as adjudged by our BERT model.

Table 2.

Public tweet summaries of the Governorship Candidates from March 1st – March 17th 2023 excluding retweets and replies

	Sanwoolu (APC)	GRVLagos(LP)	Jandor (PDP)
Query/Search Term	(APC OR Sanwoolu OR Jidesanwoolu OR Babajide Sanwoolu) AND (Lagos OR Governor)	(GRV OR GRVLagos OR LP OR Labour Party) AND (Lagos OR Governor)	(Jandor OR PDP) AND (Lagos OR Governor)
Total tweets	190188	356259	92569
Retweets	1881512	3066151	1080255
Favorited	5119776	8495579	3048653
Replies	463942	620994	301962

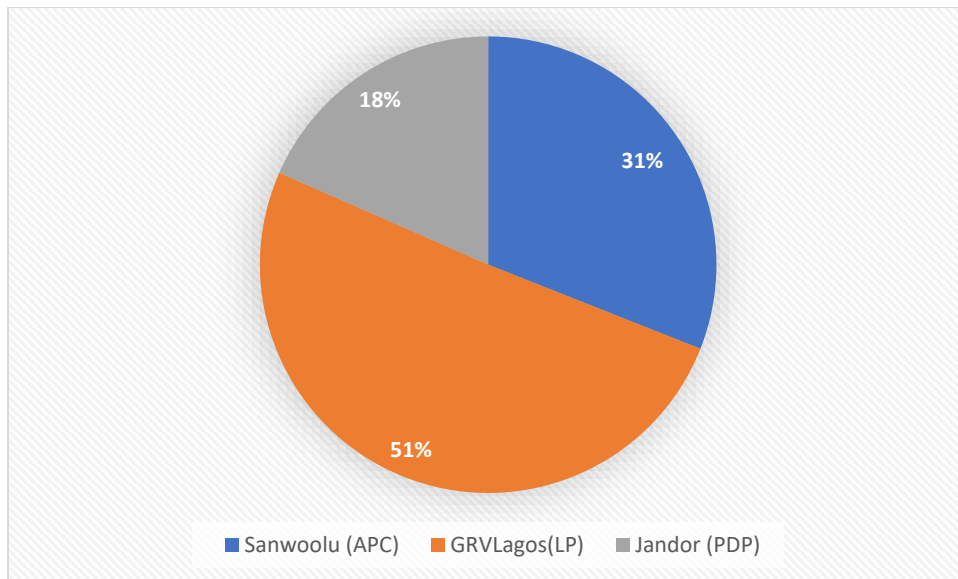


Figure 8. Total impressions from public tweets

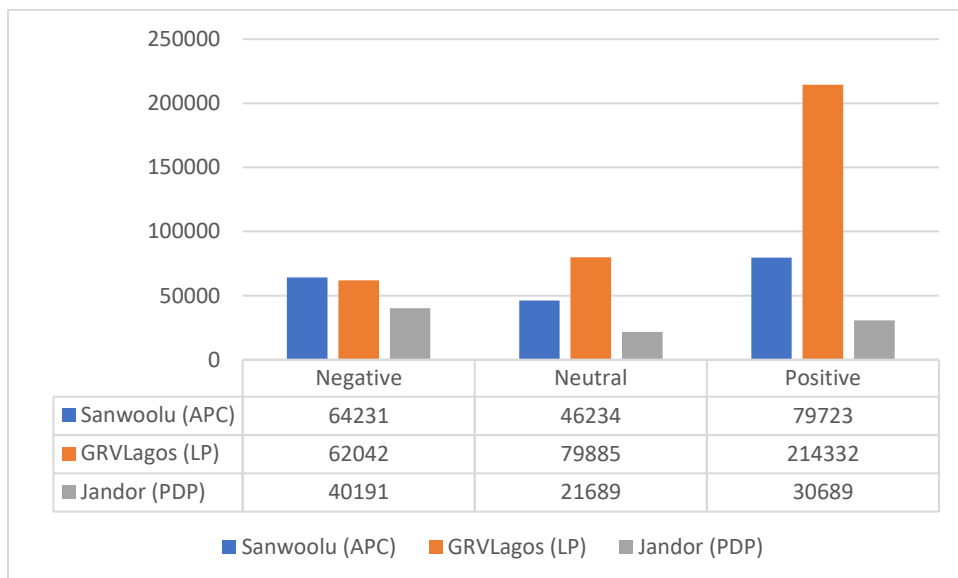


Figure 9. Summarization of Public Tweet Sentiments

e. Parameter Tuning and Performance Analysis

The tuned parameters yield different results given the various experimental stages of parameter tuning with different learning rates (LR). The results of the precision, recall and f1-measure as reflected by the variations in the learning rate are explained in Figure 9. It also shows that the learning rate at $1e-7$ gave the best performance. This shows that the smaller the learning rate, the higher the accuracy but the larger the epoch size, the higher the accuracy.

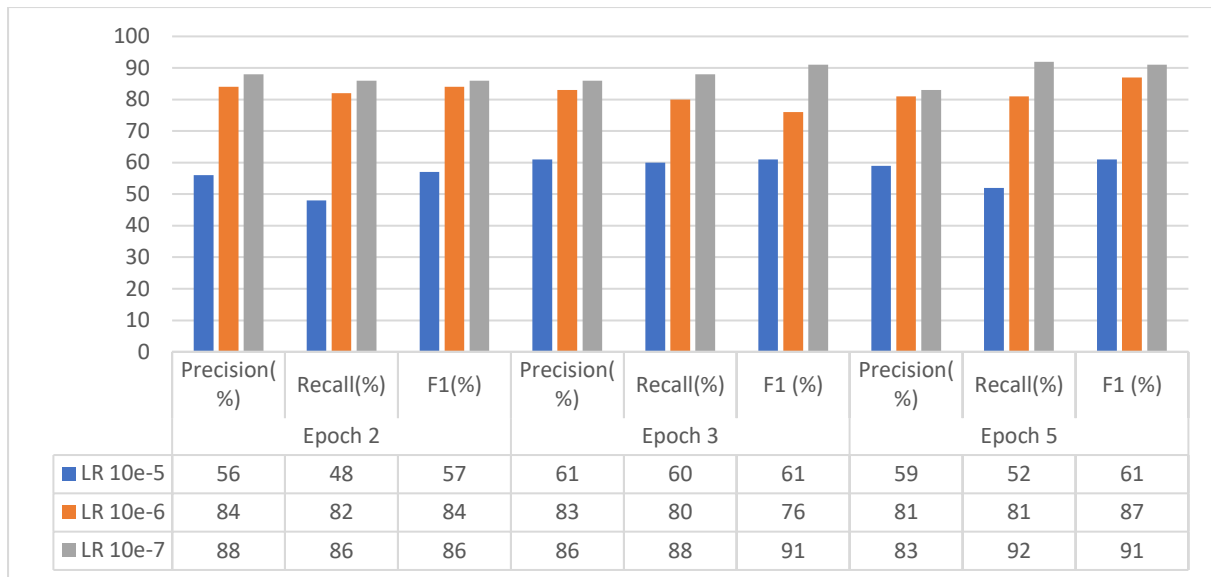


Figure 9. Results of the parameter tuning per epoch.

6. Discussion

In this study, we proposed a modified BERT model for the understanding the discourse around Lagos State 2023 gubernatorial election. Lagos State is a megacity with the highest population as well as the highest internal revenue generating state when compared with other 35 states in Nigeria. Agitations arising from the results of the just concluded Presidential election have given unprecedented attention to the State election. In order to fully understand the Twitter crowd behind each of the three candidates from the three prominent candidates, personal and public tweets were examined from March 1, 2023 to March 17, 2023. BERT model was used to establish the sentiments of the public tweets. Our experiments confirmed that:

- i. Sanwoolu, being an active government official, maintained the highest number of followers.
- ii. The dominant discourse in the negative Sanwoolu tweets is the occurrence of the popular EndSARS protest which allegedly took the lives of peaceful protesters in Lagos.
- iii. The dominant word in the GRVLagos negative tweets is the “no man’s land” phrase which is a discussion of whether he is actually the son of the soil or qualified to rule Lagos given his maternal East-Nigeria’s descent.
- iv. Sanwoolu, however, maintained the strongest social media networks with many in-power personnel in his active circle.
- v. GRVLagos has the highest twitter impressions and the highest positive impressions of the three candidates.
- vi. Jandor does not pull the twitter crowd, hence, making the outcome of the election to become a potential two-horse race between Sanwoolu and GRVLagos.

The proposed model which gave a relatively high accuracy if compared with other non-deep learning models, although developed to understand the forthcoming elections in Lagos State, can be adapted to any election scenario.

7. Conclusion

This study shows that elections can be significantly impacted by sentiment analysis research by shedding light on voter sentiment and public opinion. Sentiment analysis examines social media messages and posts, news articles, and other sources of data to ascertain the sentiment or emotion underlying them using Natural Language Processing and machine learning techniques. This study can assist political parties and candidates in understanding how voters feel about them and their policies during an election. Sentiment analysis study can uncover trends in how people react to political occasions and speeches by examining social media posts and news articles. Political campaigns can use this information to modify their strategies and tactics as necessary. For instance, if sentiment analysis reveals that people disapprove of a specific policy proposal, a campaign may change or eliminate that idea to win over more votes. Furthermore, campaigns can use sentiment analysis to pinpoint the major topics that are resonating with voters and change their messaging to highlight those issues. Overall, sentiment analysis can provide valuable insights into public opinion and the mood of the electorate, which can help political campaigns make more informed decisions and adjust their strategies to better appeal to voters.

The BERT model has also proven to be an effective sentiment model. The reason BERT model is powerful is because instead of predicting the subsequent word in the sequence, the model accounts for all words in the sequence and comes up with a deeper understanding of the context and its potency has been proven in many literature.

The actual outcome of the election under study may vary with the results in this study because it is assumed that not all eligible voters air their opinions on Twitter or even have Twitter accounts at all. Also, tweets used in this study were not location-specific, therefore, it is difficult to tell if the scraped tweets were from accounts of Lagosians. However, this study has aided our overall understanding of the Lagos State governorship election by providing insights into the networks, impressions and public sentiments of the three prominent candidates vying for the Governorship seat. In the future, authors shall consider the modified version of the BERT model such as RoBERT.

References

- Achen, C. H. (2002). Toward a new political methodology: Microfoundations and ART. *Annual review of political science*, 5(1), 423-450. <https://doi.org/10.1146/annurev.polisci.5.112801.080943>
- Allcott, H., & Gentzkow, M. (2017). Social media and fake news in the 2016 election. *Journal of economic perspectives*, 31(2), 211-236. <https://doi.org/10.1257/jep.31.2.211>
- Ascher, W. (1982). Political forecasting: The missing link. *Journal of Forecasting*, 1(3), 227-239. <https://doi.org/10.1002/for.3980010303>
- Bibi, M., Abbasi, W. A., Aziz, W., Khalil, S., Uddin, M., Iwendi, C., & Gadekallu, T. R. J. P. R. L. (2022). A novel unsupervised ensemble framework using concept-based linguistic methods and machine learning for twitter sentiment analysis. 158, 80-86. <https://doi.org/10.1016/j.patrec.2022.04.004>
- Caetano, J. A., Lima, H. S., Santos, M. F., Marques-Neto, H. T. J. J. o. i. s., & applications. (2018). Using sentiment analysis to define twitter political users' classes and their

- homophily during the 2016 American presidential election. 9(1), 1-15. <https://doi.org/10.1186/s13174-018-0089-0>
- Cameron, M. P., Barrett, P., & Stewardson, B. (2016). Can social media predict election results? Evidence from New Zealand. *Journal of Political Marketing*, 15(4), 416-432. <https://doi.org/10.1080/15377857.2014.959690>
- Carvalho, J., & Plastino, A. J. A. I. R. (2021). On the evaluation and combination of state-of-the-art features in Twitter sentiment analysis. 54(3), 1887-1936. <https://doi.org/10.1007/s10462-020-09895-6>
- Chandra, R., & Saini, R. J. I. A. (2021). Biden vs trump: Modeling US general elections using BERT language model. 9, 128494-128505. <https://doi.org/10.1109/ACCESS.2021.3111035>
- Devlin, J., Chang, M.-W., Lee, K., & Toutanova, K. (2018). Bert: Pre-training of deep bidirectional transformers for language understanding. *arXiv preprint arXiv:1810.04805*.
- Di Caro, L., & Grella, M. (2013). Sentiment analysis via dependency parsing. *Computer Standards & Interfaces*, 35(5), 442-453. <https://doi.org/10.1016/j.csi.2012.10.005>
- Fan, T.-K., & Chang, C.-H. (2010). Sentiment-oriented contextual advertising. *Knowledge and information systems*, 23, 321-344. <https://doi.org/10.1007/s10115-009-0222-2>
- Hendricks, J. A., & Schill, D. (2017). The social media election of 2016. *The 2016 US presidential campaign*, 121-150. https://doi.org/10.1007/978-3-319-52599-0_5
- Jivani, A. G. (2011). A comparative study of stemming algorithms. *Int. J. Comp. Tech. Appl*, 2(6), 1930-1938.
- Kausar, M. A., Soosaimanickam, A., Nasar, M. J. I. J. o. A. C. S., & Applications. (2021). Public sentiment analysis on Twitter data during COVID-19 outbreak. 12(2). <https://doi.org/10.14569/IJACSA.2021.0120252>
- Kwak, H., Lee, C., Park, H., & Moon, S. (2010). *What is Twitter, a social network or a news media?* Paper presented at the Proceedings of the 19th international conference on World wide web. <https://doi.org/10.1145/1772690.1772751>
- Lee, J.-S., & Hsiang, J. (2020). Patent classification by fine-tuning BERT language model. *World Patent Information*, 61, 101965. <https://doi.org/10.1016/j.wpi.2020.101965>
- Neogi, A. S., Garg, K. A., Mishra, R. K., & Dwivedi, Y. K. J. I. J. o. I. M. D. I. (2021). Sentiment analysis and classification of Indian farmers' protest using twitter data. 1(2), 100019. <https://doi.org/10.1016/j.jjime.2021.100019>
- Noble, W. S. (2006). What is a support vector machine? *Nature biotechnology*, 24(12), 1565-1567. <https://doi.org/10.1038/nbt1206-1565>
- Olabanjo, O., Wusu, A., Asokere, M., Padonu, R., Olabanjo, O., Ojo, O., . . . Aribisala, B. (2022). From Twitter to Aso-Rock: A Natural Language Processing Spotlight for Understanding Nigeria 2023 Presidential Election. <https://doi.org/10.20944/preprints-202210.0238.v1>
- Oluro, M. J., & Bamigbose, J. O. (2021). Legislative Cross-carpeting, Multiparty System and the Challenges of Democratic Good Governance in Nigeria. *Journal of Public Administration and Governance*, 11(1), 2639-2639. <https://doi.org/10.5296/jpag.v11i1.18151>
- Pisner, D. A., & Schnyer, D. M. (2020). Support vector machine *Machine learning* (pp. 101-121): Elsevier. <https://doi.org/10.1016/B978-0-12-815739-8.00006-7>

- Ravichandiran, S. (2021). *Getting Started with Google BERT: Build and train state-of-the-art natural language processing models using BERT*: Packt Publishing Ltd.
- Razzaq, M. A., Qamar, A. M., & Bilal, H. S. M. (2014). *Prediction and analysis of Pakistan election 2013 based on sentiment analysis*. Paper presented at the 2014 IEEE/ACM International conference on advances in social networks analysis and mining (ASONAM 2014). <https://doi.org/10.1109/ASONAM.2014.6921662>
- Remmer, K. L. (1993). The political economy of elections in Latin America, 1980–1991. *American Political Science Review*, 87(2), 393-407. <https://doi.org/10.2307/2939049>
- Roberts, M. E. (2018). What is political methodology? *PS: Political Science & Politics*, 51(3), 597-601. <https://doi.org/10.1017/S1049096518000537>
- Sanders, E. (2023). *Vox populi. On Forecasting Elections with Twitter*.
- Schmidt, T., Fehle, J., Weissenbacher, M., Richter, J., Gottschalk, P., & Wolff, C. (2022). *Sentiment Analysis on Twitter for the Major German Parties during the 2021 German Federal Election*. Paper presented at the Proceedings of the 18th Conference on Natural Language Processing (KONVENS 2022).
- Singh, P., Sawhney, R. S., & Kahlon, K. S. (2017). *Predicting the outcome of Spanish general elections 2016 using Twitter as a tool*. Paper presented at the International Conference on Advanced Informatics for Computing Research. https://doi.org/10.1007/978-981-10-5780-9_7
- Somula, R., Dinesh Kumar, K., Aravindharamanan, S., & Govinda, K. (2020). Twitter sentiment analysis based on US presidential election 2016 *smart intelligent computing and applications* (pp. 363-373): Springer. https://doi.org/10.1007/978-981-13-9282-5_34
- Suthaharan, S. (2016). Support vector machine *Machine learning models and algorithms for big data classification* (pp. 207-235): Springer. https://doi.org/10.1007/978-1-4899-7641-3_9
- Tumasjan, A., Sprenger, T., Sandner, P., & Welpe, I. (2010). *Predicting elections with twitter: What 140 characters reveal about political sentiment*. Paper presented at the Proceedings of the International AAAI Conference on Web and Social Media. <https://doi.org/10.1609/icwsm.v4i1.14009>
- Tumasjan, A., Sprenger, T. O., Sandner, P. G., & Welpe, I. M. (2011). Election forecasts with Twitter: How 140 characters reflect the political landscape. *Social science computer review*, 29(4), 402-418. <https://doi.org/10.1177/0894439310386557>
- Wang, H., Can, D., Kazemzadeh, A., Bar, F., & Narayanan, S. (2012). *A system for real-time twitter sentiment analysis of 2012 us presidential election cycle*. Paper presented at the Proceedings of the ACL 2012 system demonstrations.
- Wani, G., & Alone, N. (2014). A survey on impact of social media on election system. *International journal of computer science and information technologies*, 5(6), 7363-7366.
- Wei, X., & Croft, W. B. (2006). *LDA-based document models for ad-hoc retrieval*. Paper presented at the Proceedings of the 29th annual international ACM SIGIR conference on Research and development in information retrieval. <https://doi.org/10.1145/1148170.1148204>
- Widodo, A., & Yang, B.-S. (2007). Support vector machine in machine condition monitoring and fault diagnosis. *Mechanical systems and signal processing*, 21(6), 2560-2574. <https://doi.org/10.1016/j.ymssp.2006.12.007>

- Yavari, A., Hassanpour, H., Rahimpour Cami, B., & Mahdavi, M. J. I. J. o. E. (2022). Election Prediction Based on Sentiment Analysis using Twitter Data. 35(2), 372-379. <https://doi.org/10.5829/IJE.2022.35.02B.13>
- Yu, H., & Yang, J. (2001). A direct LDA algorithm for high-dimensional data—with application to face recognition. *Pattern recognition*, 34(10), 2067-2070. [https://doi.org/10.1016/S0031-3203\(00\)00162-X](https://doi.org/10.1016/S0031-3203(00)00162-X)