

Analyzing Sentiment and Community Structures in Tweets on the 2024 U.S. Presidential Election

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Social media platforms like X (Twitter) have been playing an important role in shaping public opinion and political discourse, especially around events like the 2024 US Presidential Election. This research analyzes 138,586 tweets to investigate the association of sentiment with user interactions and community structures in online political conversations. We used NLP techniques to perform sentiment analysis of emotional tones and tracked shifts in sentiment around major political events, such as debates and legal controversies. Social graph analysis, through the use of community detection methods such as the Louvain algorithm, uncovered a network of 104,937 users organized into 112 significant communities, many of which function as ideological echo chambers. Our findings illustrate how political events shape sentiment dynamics, where there is a fluctuation of support between candidates Kamala Harris and Donald Trump. This study also underlines how online polarization and echo chambers shape user engagement. These insights are valuable to the understanding of digital political discourses and for the devising of possible strategies in mitigating division and creating meaningful online interactions during periods of elections.

Social Media Analysis | Political Polarization | Sentiment Analysis | Community Detection | Echo Chambers

1. Introduction

The 2024 US Presidential Election has highlighted how social media has transformed political discourse. Platforms like X (formerly known as Twitter) allow millions of users to share opinions, connect with others, and align with ideological communities. However, these platforms also amplify polarization, creating echo chambers where users are exposed predominantly to views that reinforce their preexisting beliefs, limiting exposure to diverse perspectives.

This paper investigates the relationship between sentiment, user interactions, and political events during the 2024 election cycle. By combining natural language processing (NLP) with social graph analysis, we explore how communities form and evolve around key political moments, such as debates, campaign announcements, and controversies. NLP techniques allow us to evaluate the emotional tone of tweets, detect themes, and track shifts in public opinion. Meanwhile, social graph analysis helps us identify community structures and understand their dynamics.

A key focus of our study is on echo chambers in online political discourse. These isolated communities consume content that aligns with their views, limiting engagement with opposing perspectives. By measuring sentiment within and between these communities, we explore how polarization spreads across networks and how social media contributes to political division.

In conclusion, our work underscores the significant role of social media in shaping modern political discourse. By analyzing sentiment and community structures, we gain insights into how these platforms foster polarization and create echo chambers. This study provides a foundation for addressing the challenges of reducing division, fostering dialogue, and encouraging meaningful interactions across ideological lines.

Expected Outcomes. This study will provide insights into several important aspects of online political discourse during the 2024 U.S. Presidential Election, including:

- **Sentiment Dynamics:** The nature of public sentiment flow following major political events, such as debates and campaign announcements, to provide a clearer understanding of the emotional tone of the discussion.

Significance Statement

Social media platforms are powerful tools for political discourse, yet they also amplify polarization and foster echo chambers, particularly during high-stakes events like elections. This study provides an in-depth analysis of online interactions during the 2024 U.S. Presidential Election, uncovering how sentiment and community dynamics evolve in response to political events. By leveraging network science and natural language processing, this research sheds light on the mechanisms driving community formation and polarization, offering a roadmap for mitigating divisiveness in online spaces. Our findings contribute to the growing field of digital political analysis, with potential applications in promoting balanced discourse, shaping platform policies, and informing future election strategies.

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- **Community Structure:** Identification and characterization of distinct political communities formed around candidates, ideologies, and key issues, and an analysis of their interactions.
- **Polarization and Echo Chambers:** An assessment of the level of polarization and the extent to which echo chambers influence users to avoid diverse points of view.
- **Event-Based Impacts:** Analyzing changes in sentiment and dynamic community structures in response to major campaign events.

Importance. This paper contributes to the fast-growing literature on the role of social media in political discourse, with a focus on the 2024 U.S. Presidential Election. By understanding how sentiment evolves and how communities are structured on platforms such as X, we advance the understanding of the mechanisms behind polarization and public engagement. Furthermore, this work presents practical recommendations to improve the quality of online political discussions, foster constructive interactions, and reduce ideological fragmentation.

Results

The key focus areas of our analytical work included: the structure of social graphs, community detection inside the social graphs, and sentiment analysis of tweets which are connected to the 2024 US Presidential Election. These dimensions were studied for the development of sentiment and communities as a function of such major political events.

A. Network Overview and Structural Properties. We constructed a social graph comprising interactions such as mentions and replies extracted from 138,586 unique tweets. To ensure a consistent analysis, we removed 18,667 non-English tweets. The resulting graph provides a comprehensive representation of user interactions during the 2024 U.S. election discussions.

The graph contains a total of **104,937 nodes** (unique users) and **99,068 edges**, comprising **93,318 reply edges** and **5,750 mention edges**.

A.1. Largest Component Analysis. The largest connected component includes **64,605 nodes** and **80,573 edges**. This component represents the core of the network where most interactions occur, highlighting clusters of users engaging actively in discussions.

A.2. In-Degree and Out-Degree Statistics. An analysis of node in-degrees and out-degrees reveals the following patterns:

- **In-Degree:** The average in-degree is **0.88**, with a median of **0** and a mode of **0**. This indicates that at least half of the users do not receive any mentions or replies. However, a maximum in-degree of **1,027** signifies the presence of highly referenced nodes or hubs.
- **Out-Degree:** The average out-degree is also **0.88**, but the median is **1** and the mode is **1**. This suggests that most users engage with at least one other user. The maximum out-degree of **144** indicates that while some users actively mention or reply to many others, they are far fewer compared to highly referenced nodes.

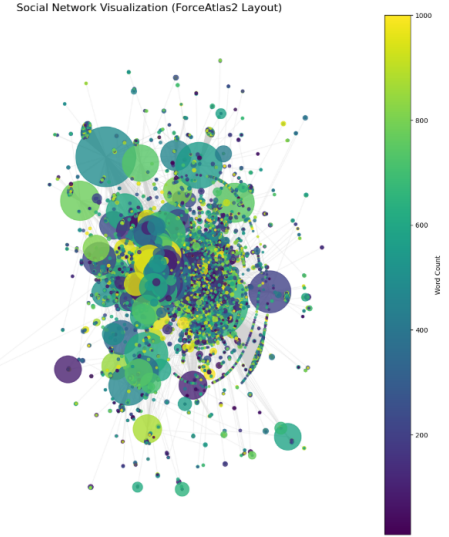


Fig. 1. Visualization of the social graph representing user interactions during the 2024 U.S. Presidential Election. Nodes correspond to individual users, while edges represent interactions such as replies and mentions. The graph reveals dense clusters indicative of distinct communities aligned with political affiliations.

B. Community Structures and Sentiment Analysis. We employed multiple approaches to detect and analyze communities within the social graph, focusing on understanding the network’s structure, political alignments, and sentiment dynamics. The methods used include the Louvain algorithm, sentiment-based community detection, and hashtag-based analysis.

B.1. Louvain-Based Community Detection. The Louvain algorithm was applied to the largest connected component of the graph, revealing a modular structure with **112 significant communities** (with at least 5 nodes each). The largest communities included thousands of users, such as **Community 2** with **3,795 nodes** and **Community 0** with **2,491 nodes**. This clustering highlights polarized groups where users predominantly engage within their own communities, characteristic of echo chambers.

Sentiment analysis within these Louvain-detected communities provided deeper insights into political support. For instance, **Community 0** exhibited a strong split, with **1,248 tweets** supporting Kamala, **1,565 tweets** opposing Kamala, and **466 tweets** opposing Trump. Neutral sentiment was also prominent, with **1,214 tweets** falling into this category. Such distributions illustrate the fragmented nature of political discourse, where both support and opposition coexist within the same community.

Across the detected communities, **70 communities** showed predominant support for Kamala, while **13 communities** leaned toward Trump. **29 communities** remained largely neutral, reflecting the diversity of engagement and sentiment in the network.

B.2. Sentiment-Based Community Detection. In addition to Louvain-based clustering, we implemented a custom sentiment-based algorithm to classify users into predefined communities based on their tweet content. This method identified:

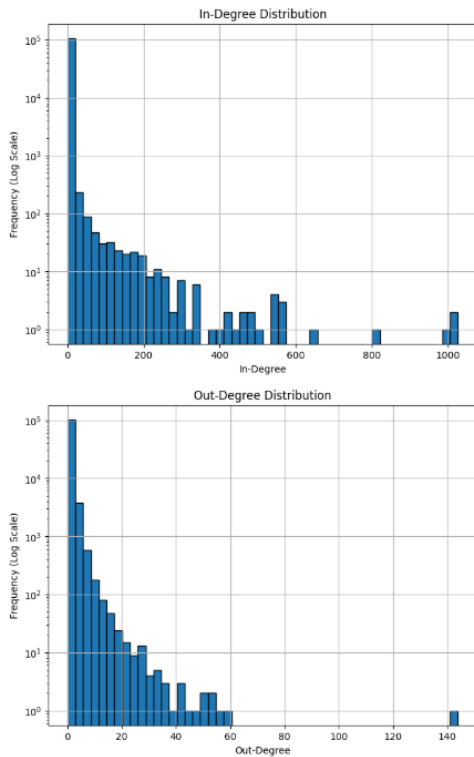


Fig. 2. In-degree and out-degree distributions of users in the social graph. The in-degree represents the number of times a user is mentioned or replied to, while the out-degree reflects the number of interactions initiated by the user. The graph highlights the presence of influential hubs (high in-degree) and active users (high out-degree) in the network.

- 13,096 Trump Supporters
- 37,608 Kamala Supporters
- 56,273 Neutral Users

The average sentiment scores across these communities reveal interesting trends. Trump and Kamala supporters exhibited similarly positive sentiment, with average scores of **5.27** and **5.26**, respectively. Neutral users, on the other hand, showed a lower average sentiment of **2.72**, indicating a more reserved or balanced stance.

B.3. Hashtag-Based Community Detection. Hashtag analysis provided another lens to detect and interpret communities. Out of the dataset, **3,799 tweets** contained hashtags, while the majority (**84,822 tweets**) did not. This lack of hashtags reflects a broader trend where many users participate in conversations without tagging specific themes.

Despite this, certain hashtags formed distinct communities. The largest hashtag-based community was centered around **#trump2024**, with **304 users**. Other prominent hashtags included **#maga** (**142 users**), **#biden** (**117 users**), and **#bidenharris2024** (**38 users**). Beyond these, community sizes declined steeply, with many hashtags linked to only a handful of users, indicating high diversity but low density in hashtag usage.

Interestingly, the largest “community” by default consisted of users who did not use any hashtags, comprising **61,822 members**. This suggests that while hashtag-based communi-

ties reveal key narratives and alignments, a significant portion of the discourse occurs outside hashtag-driven interactions.

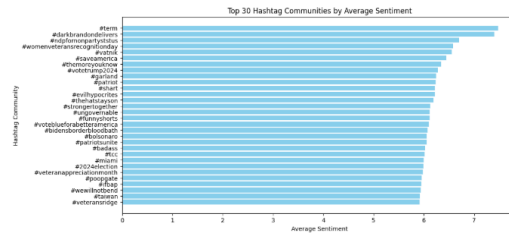


Fig. 3. Average sentiment scores for the top 30 hashtag-based communities. Positive sentiment clusters are associated with hashtags such as **trump2024** and **bidenharris2024**, while highly negative sentiment is observed in smaller, polarized hashtag groups. The figure demonstrates the diversity of engagement within hashtag-driven interactions.

B.4. Key Insights. The combination of these methods underscores the complex and fragmented nature of the social graph. Louvain-based communities highlight polarized clusters, sentiment-based analysis reveals distinct ideological alignments, and hashtag-based detection captures narrative-driven groups. Together, these approaches provide a multi-faceted understanding of user interactions, political engagement, and sentiment distribution within the network.

C. Sentiment Polarity and Echo Chambers.

C.1. Identifying Echo Chambers in Louvain Communities. The sentiment analysis of the Louvain-detected communities reveals clear patterns of political polarization, indicative of echo chambers. Notably, several communities exhibit strong sentiments in favor of either Trump or Kamala, reinforcing the presence of ideologically insular groups.

The sentiment analysis of the Louvain communities reveals distinct patterns of political polarization, highlighting the existence of echo chambers, where users are predominantly exposed to like-minded opinions. **Community 43**, with an average sentiment score of **5.35**, stands out as a prime example of such an echo chamber, reflecting strong positive sentiment, likely in support of a particular political ideology. Similarly, **Community 39** (average sentiment: **5.25**) shows a strong alignment with a particular viewpoint, contributing to the amplification of specific political ideologies within the community.

On the other hand, several communities exhibit much lower average sentiment scores, such as **Community 105** (1.34) and **Community 107** (2.83), which indicates highly negative or critical sentiments. These communities may be expressing dissatisfaction or frustration with the opposing political faction, further deepening the divide. **Community 99** (average sentiment: **3.56**) and **Community 109** (average sentiment: **3.07**) also reflect a more contentious, polarized dynamic, where users likely reinforce their negative opinions about specific political issues or candidates.

Other communities, like **Community 11** (average sentiment: **4.96**), **Community 49** (average sentiment: **4.25**), and **Community 63** (average sentiment: **4.24**), show moderately strong sentiment, suggesting a more consistent alignment within the group, but still contributing to the larger trend of polarization. These findings suggest that the

dynamics of social media discourse during the election period are shaped by echo chambers, where communities reinforce particular political views, whether positive or negative. The high sentiment scores in these communities indicate that social media platforms play a significant role in amplifying polarized political views, often creating insular spaces that make it difficult for dissenting opinions to gain traction.

These findings highlight how social media discourse during the election period is shaped by echo chambers. Communities with high sentiment scores suggest that political views within these groups are amplified, reducing the likelihood of encountering dissenting opinions.

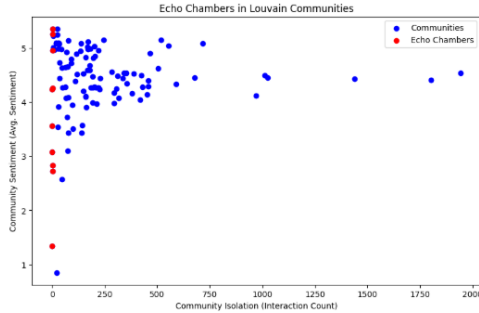


Fig. 4. Sentiment analysis of Louvain-detected communities, illustrating echo chambers. Communities with high average sentiment scores exhibit strong ideological alignment, while others display negative sentiment reflecting opposition to specific political candidates or issues.

C.2. Sentiment-Based Echo Chambers in Predefined Communities.

In addition to Louvain-detected clusters, sentiment analysis of predefined communities (Trump supporters, Kamala supporters, and neutral users) reveals further evidence of echo chambers. Notably:

- **Trump Community:** Despite its predefined label, this community exhibits a strong average sentiment score of **5.27**, reflecting consistent pro-Trump views.
- **Kamala Community:** Interestingly, this community shows an average sentiment score of **5.26** in favor of Trump, suggesting ideological inconsistency or cross-ideological alignment.

These results indicate that echo chambers are not strictly bound by community labels. Some communities labeled as supporting one candidate may express sentiments aligned with the opposing ideology, pointing to nuanced or fluid political alignments.

C.3. Echo Chambers in Hashtag-Based Communities. Analyzing isolated communities formed around hashtags reveals additional echo chambers characterized by limited interaction outside their groups. These communities tend to focus on highly specific and polarizing topics, fostering environments where certain narratives are reinforced.

Many of these communities are small, often consisting of just **2 to 4 members**. For example, hashtags such as *#traitor*, *#buildthewall*, and *#trumpcult* each involve **only 4 users**. This small size suggests insular discussions where members are unlikely to encounter opposing viewpoints.

The topics within these hashtag communities are intensely polarized, often reflecting extreme political positions. Hash-tags like *#trumpcult*, *#goptraitors*, and *#votebluetostopthetupid* illustrate left-leaning opposition to Trump, while hash-tags like *#immigrationreformnow* and *#gopbetrayedamerica* reflect right-leaning sentiments. The homogeneity within these groups reinforces existing beliefs, making them potential echo chambers.

C.4. Key Insights and Implications. The presence of echo chambers in these various forms—Louvain communities, sentiment-based clusters, and hashtag groups—has significant implications for political discourse on social media. These echo chambers:

- **Amplify Polarization:** Closed-group interactions reduce exposure to diverse viewpoints, deepening ideological divides.
- **Limit Critical Thinking:** The absence of opposing perspectives can foster rigid, unchallenged beliefs.
- **Spread Misinformation:** Content that aligns with group beliefs is more likely to be accepted and shared uncritically.

C.5. Conclusion. Our analysis demonstrates that social media platforms can cultivate environments where users predominantly interact with like-minded individuals. These echo chambers contribute to political polarization by amplifying specific viewpoints and limiting constructive dialogue. Addressing this challenge requires strategies to encourage cross-community interaction and promote exposure to diverse perspectives, fostering healthier political discourse online.

D. Time Events and Sentiment Shifts.

D.1. Key Events in May, June, and July 2024 and Their Impact on Sentiment.

May 2024: In May, the sentiment toward Donald Trump and Kamala Harris was shaped by campaign events, legal developments, and national discussions on economic issues.

Campaign Events and Rallies: Donald Trump held multiple rallies in key battleground states, which energized his base(1). Concurrently, Kamala Harris focused on outreach events related to healthcare and climate change, likely boosting her support(2).

Legal Developments: Trump faced ongoing legal challenges, including investigations into his business dealings and alleged election interference. These issues may have generated negative sentiment among some groups, while galvanizing his supporters(3)(2).

Economic Concerns: Public discourse centered on economic issues such as inflation and the rising cost of living. Dissatisfaction with the Biden administration’s handling of the economy likely increased opposition toward Kamala among Trump supporters. Conversely, Kamala’s focus on healthcare and climate policies garnered support from her base(2)(4).

These factors contributed to higher support for Kamala (**9,278 tweets**) compared to Trump (**5,775 tweets**) in May. The legal controversies surrounding Trump and Kamala’s focus on key policy areas appear to have influenced public sentiment during this period.

June 2024: June witnessed a significant increase in Kamala's support and a notable decline in Trump's support, driven by several critical events.

Trump's Legal Battles Intensify: Trump's legal challenges, particularly regarding the January 6th Capitol riot and election interference, received widespread media coverage. This likely fueled opposition to Trump (**11,346 tweets**) and contributed to his reduced support (**5,152 tweets**) (5)(3).

Kamala Harris and the Biden Administration: Kamala Harris continued her advocacy on climate change, student debt relief, and police reform. These initiatives likely strengthened support among her base. Debates on healthcare and economic recovery also influenced sentiment toward Kamala(4).

Abortion Rights Debates: Intense discussions on abortion rights, spurred by state-level restrictions, highlighted Kamala's stance on protecting women's rights. This issue likely increased her support, while divisions within Trump's conservative base may have contributed to greater opposition(6).

The surge in Kamala's support (**13,767 tweets**) compared to Trump's (**5,152 tweets**) reflects the impact of these developments on public sentiment.

July 2024: In July, sentiment became more polarized, with both candidates experiencing decreased support and an increase in neutral sentiment.

Campaign Intensification: As the election drew closer, both Trump and Kamala escalated their campaign efforts. The intensity of political messaging likely led to voter polarization and fatigue, reducing support for both candidates(7).

Economic Concerns Persist: Inflation and labor market challenges remained prominent issues. Trump's supporters expressed dissatisfaction with the administration's economic performance, while Kamala's camp continued emphasizing recovery efforts(8).

Fourth of July Patriotism: Patriotic sentiments during the Fourth of July celebrations may have bolstered support for Trump. This period of heightened national pride influenced shifts in sentiment, especially among Trump's base(9).

Support for both candidates dropped sharply in July, with Trump receiving **2,610 tweets** and Kamala **1,531 tweets**. The rise in neutral tweets (**31,611**) suggests increased voter indecisiveness or disengagement as political and economic issues continued to dominate discourse.

D.2. Conclusion. The sentiment analysis from May to July 2024 highlights the influence of key political events on public opinion. In June, the surge in opposition to Trump, coupled with increased support for Kamala, can be attributed to Trump's legal battles and Kamala's policy initiatives. By July, the decline in support for both candidates reflects voter fatigue and shifting political dynamics as the election approached. These findings underscore how campaign activities, legal issues, and economic concerns shape sentiment trends on social media.

Discussion

Interpretation of Results. The results of this study clearly illustrate the strong polarization present in online discourse surrounding the 2024 U.S. Presidential Election. The social graph analysis, community detection, and sentiment analysis

all highlight the existence of distinct political clusters, with communities largely aligned with either Kamala Harris or Donald Trump, as well as a significant portion of neutral users. The presence of echo chambers, particularly within the Louvain-detected communities and hashtag-based groupings, suggests that political views are often amplified within like-minded groups, limiting exposure to opposing viewpoints. This fragmentation of the discourse has the potential to reinforce existing political beliefs, fostering division within the electorate. Moreover, sentiment analysis reveals a strong connection between political identity and sentiment, with high levels of both positive and negative emotions, indicating a deeply polarized public opinion that is likely to affect future political engagement and discourse.

Limitations and Future Work. While this study provides valuable insights into the structure of political discourse on social media, several limitations should be acknowledged. The dataset (10), composed of 138,586 tweets, may not fully capture the breadth of online discourse, as it focuses on English-language tweets and may exclude non-English-speaking communities. Additionally, the sentiment analysis, while effective for identifying general political alignments, may not fully account for the subtleties and complexities of individual expressions, particularly when it comes to sarcasm or nuanced political discourse. Future research could explore refining sentiment analysis techniques, perhaps incorporating more sophisticated models capable of better detecting these subtleties. Further, expanding the dataset to include tweets from other languages or incorporating data from other platforms, such as Facebook or Reddit, could provide a more comprehensive understanding of the online political environment. Additionally, investigating the role of bots or automated accounts in shaping online discourse would be an important direction for future studies, as these entities may disproportionately influence public sentiment and community dynamics.

Methods

The analysis presented in this study was conducted using a Jupyter notebook, which includes all the detailed steps for data collection, sentiment analysis, and social graph construction. The notebook also contains the code for community detection and the sentiment-based analyses used to assess polarization and echo chambers. For full transparency and reproducibility, the complete notebook is available at the following link: [Final Project Notebook](#).

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