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Daniel Maya Bonilla

University of Louisville, daniel.mayabonilla@louisville.edu

Samuel Iradukunda

University of Louisville, samuel.iradukunda@louisville.edu

Pamela Thomas

University of Louisville, pamela.thomas.1@louisville.edu

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Cover Page Footnote

We extend our appreciation to Dr. Pamela Thomas, whose invaluable guidance, resourcefulness, and unwavering support have been instrumental in the successful completion of this research project. Her expertise and mentorship have been a driving force behind our work. We also recognize and appreciate the contributions of the online communities and users whose candid and diverse comments served as the foundation of our analysis. Their active participation in online discussions has provided us with rich and meaningful data, enabling us to gain insights into public sentiment. We also express our gratitude to the University of Louisville for providing us with the necessary resources and tools to carry out this research. The university's state-of-the-art facilities and cutting-edge technologies have empowered us to conduct our research effectively, efficiently, and in a timely manner.

Sentiment Analysis of Public Perception Towards Elon Musk on Reddit (2008-2022)

Daniel Maya Bonilla¹, Samuel Iradukunda¹, Pamela Thomas¹

¹ The University of Louisville, Louisville, KY,

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ABSTRACT

As Elon Musk's influence in technology and business continues to expand, it becomes crucial to comprehend public sentiment surrounding him in order to gauge the impact of his actions and statements. In this study, we conducted a comprehensive analysis of comments from various subreddits discussing Elon Musk over a 14-year period, from 2008 to 2022. Utilizing advanced sentiment analysis models and natural language processing techniques, we examined patterns and shifts in public sentiment towards Musk, identifying correlations with key events in his life and career. Our findings reveal that public sentiment is shaped by a multitude of factors, including his business ventures, controversies, and personal behavior. This study offers valuable insights into the dynamics of public opinion towards influential figures in the digital age.

KEYWORDS: Elon Musk, sentiment analysis, public perception, Reddit, 2008-2022, social media, data analysis

INTRODUCTION

Elon Musk, the CEO of *Tesla*, and *SpaceX*, has emerged as a key player in the technology and business sectors. His ambitious projects, coupled with his contentious remarks, have captured significant public attention, leading to diverse perspectives on his character and ventures. Given Musk's growing influence, assessing public sentiment towards him is crucial for understanding the implications of his actions and statements.

In this study, we employ sophisticated *natural language processing (NLP)* techniques, using the *Twitter-RoBERTa-Base* for Sentiment Analysis, to systematically investigate the public's perception of Elon Musk from 2008 to

2022. We analyze comments across various subreddits, including *r/spacex*, *r/news*, and *r/politics*, among others, to capture a diverse range of opinions and discussions related to Musk's ventures and public presence.

Our analysis aims to uncover patterns and shifts in sentiment, establishing correlations with pivotal events in Musk's life and career. We also explore the role of media coverage and the impact of specific incidents on public sentiment. By employing state-of-the-art NLP models, our study delves into the nuances of online discourse and offers a detailed understanding of public opinion dynamics in the context of influential figures like Elon Musk.

This research contributes to the broader understanding of how public sentiment towards influential figures evolves and is shaped by individual actions, media portrayal, and other contextual factors.

Our methodology and findings offer valuable insights for future studies on public opinion and sentiment analysis in the age of social media.

METHODOLOGY

Our methodology was designed to analyze text related to Elon Musk on various subreddits. The process was broken down into the following stages:

Data Retrieval Process: We sourced comments associated with Elon Musk from a curated list of subreddits. This data was collected using a combination of web scraping tools and APIs, primarily the Reddit Pushshift API [13]. We implemented multi-threaded processes to efficiently handle the large volume of data spanning from 2008 to 2022. It's

important to note that our initial dataset was obtained without any pre-processing or filtering.

Data Source Clarification: While our primary data source was Reddit, we also considered mentions of Elon Musk on other social media platforms, such as twitter comments to provide a holistic view. However, for the purpose of this study, we focused solely on Reddit comments.

Subreddit Selection: Our choice of subreddits was based on their relevance to Elon Musk and his ventures. Table 1 provides a comprehensive list of these subreddits. We ensured that our data was representative by selecting a mix of general and niche subreddits.

TABLE I: Subreddits list

Main Subreddits	Targeted	Miscellaneous
elonmusk	TeslaMotors	elonmuskquote
SpaceX	SelfDrivingCars	news
Futurology	SolarCity	stocks
Technology	worldnews	twitter
business	investing	todayilearned
politics	askreddit	CryptoCurrency
space	Conservative	memes
Bitcoin	conspiracy	Libertarian
dogecoin		

Data Filtering: To ensure the quality of our analysis, we applied a rigorous filtering process. This involved three crucial steps. One, filtered out any comments not originating from our target list of subreddits. Two, employing NLP techniques to calculate a readability score, ensuring the text's quality was optimal for analysis. Three, we pre-processed the text by removing unnecessary sequences, stop words, and other irrelevant content that could potentially interfere with the accuracy of our sentiment analysis.

Sentiment analysis: Sentiment analysis, a cornerstone of our methodology, is a specialized technique within NLP. It discerns and categorizes the emotional tone or sentiment embedded in a text. For our study, this technique was pivotal

in determining the overarching sentiment of comments related to Elon Musk. We employed the RoBERTa [3] model for this purpose. RoBERTa, an optimized variant of the BERT model, is renowned for its capability to process sequential data and capture intricate language patterns. Before its application to our dataset, we fine-tuned this model on a dataset comprising comments labeled with sentiments. This fine-tuning ensured the model was attuned to the nuances of sentiment expression specific to discussions about Elon Musk.

Challenges and Limitations: Distinguishing between comments genuinely related to Elon Musk and those that were definitely a limitation of the approach we took. For instance, terms like "Elon University" [1] and "Musk" in the context of a scent [2] posed potential pitfalls. To address this, we implemented advanced filtering techniques to ensure the accuracy of our dataset. Another challenge was the vast volume of data. Reddit, being one of the largest online communities, has millions of comments posted daily. To manage this, we employed multi-threaded processes and optimized our data retrieval methods to focus on the most relevant subreddits and time frames. Additionally, sentiment analysis, while powerful, has its limitations. The complexity of human emotions and the nuances in language mean that no model can achieve 100% accuracy. However, by using the RoBERTa [3] model and fine-tuning it to our specific dataset, we aimed to maximize the accuracy and reliability of our sentiment analysis.

Data Visualization Techniques: Leveraging Python packages, specifically Matplotlib and Seaborn, renowned for their flexibility and robustness in data representation. Our visualizations encompassed a range of charts and plots. Sentiment distributions across subreddits were depicted using histograms and pie charts, allowing us to quickly discern overarching patterns or notable outliers. Time-series plots were another essential tool, enabling us to track sentiment

evolution over the years and correlate these shifts with significant events or announcements related to Elon Musk.

Insights from Visualization: Our visualizations served as a lens to understand the diverse perceptions of different Reddit communities towards Elon Musk. Comparative bar charts highlighted sentiment variations across subreddits, while heatmaps focused on keyword co-occurrence with sentiments. These tools helped us identify specific triggers for sentiment fluctuations, such as product launches or controversial statements.

RESULTS

III-A. Overview of Sentiment Distribution

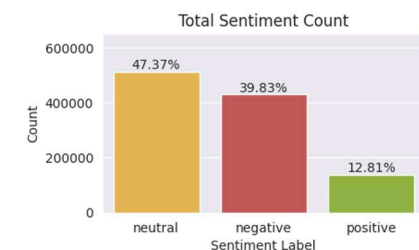


Fig. 1: Percentage of Neutral, Negative, and Positive comments from Subreddits.

After an exhaustive process of scraping, filtering, and organizing the data, we discovered that 47.37% of all the comments were neutral, 39.83% were negative, and 12.81% were positive, as illustrated in Figure 1. This distribution reveals a substantial proportion of neutral sentiments. This might be attributed to a combination of factors, including the complexity of language in the comments, such as poor grammar and spelling, or the simultaneous expression of both positive and negative sentiments, leading to a neutral classification. Furthermore, the specific nature of topics discussed in various subreddits could also contribute to this pattern.

III-B. Yearly Analysis of Sentiment

A closer inspection of the data,

presented in Figure 2, reveals insights into the temporal dynamics of sentiment surrounding Mr. Musk. Discussions in the selected subreddits did not begin to gain traction until 2012. Interestingly, no single year exhibited more positive than negative comments. The ratio between negative and positive sentiments experienced considerable fluctuations, with a significant shift starting in 2018. Throughout 2018, Mr. Musk faced challenges. In March, Tesla faced financial struggles. By June, there were safety concerns, and by September, personal controversies arose [4], [5].

III-C. Monthly Analysis of 2018

Figure 3 presents a detailed analysis of 2018, a particularly tumultuous year for Mr. Musk. July stands out with the highest negativity, coinciding with an international incident involving a Thai football team and subsequent public disagreements [6]. This event led to an acute spike in negative sentiments due to Mr. Musk's interactions with a British diver, Vern Unsworth. The public response was overwhelmingly critical, reflecting both the gravity of the situation and the polarized opinions about Mr. Musk's involvement. Moreover, 2018 was marked by a series of other challenges that impacted public sentiment. For instance, the significant financial loss at Tesla, coupled with concerns over the safety of autopilot systems, contributed to the broader negative perception [5]. The online communication phenomena may have amplified these sentiments, with news platforms and social media channels providing forums for vocal criticism. The complex interplay of these factors led to 2018 being a critical inflection point in public sentiment regarding Mr. Musk.

III-D. Twitter Acquisition in 2022

In April 2022, as seen in Figure 4, Mr. Musk's acquisition of Twitter marked a distinctive shift, generating a myriad of opinions [7]. The acquisition was celebrated by some as a bold entrepreneurial move, indicative of Mr. Musk's influence and innovation. For others, however, it raised concerns about the concentration of power and the potential for manipulation of a platform central to public discourse.

The media's role in shaping these perceptions was evident. Positive news coverage emphasized Mr. Musk's business acumen, while critical reports focused on potential ethical implications and conflicts of interest. The nature of the news and online discussions may have further polarized opinions, creating a dichotomy in the sentiment. This event underscores the complex relationship between media coverage, online communication dynamics, and public sentiment. Furthermore, the contrast in positive and negative sentiments in 2022 could be indicative of a broader trend in how significant business decisions by public figures are perceived and debated in online platforms.

III-E. Online Communication Phenomena

The "online disinhibition effect" noted in Figure 4 plays a prominent role in shaping the sentiment observed in our study. This phenomenon, where online communication can sometimes encourage more negative behavior compared to face-to-face interactions, may have contributed to the amplification of negative sentiments in certain instances [8].

Furthermore, the nature of online platforms and the anonymity they provide can influence how opinions are expressed and perceived. Our analysis shows heightened levels of negative sentiment within the comments sections of news articles,

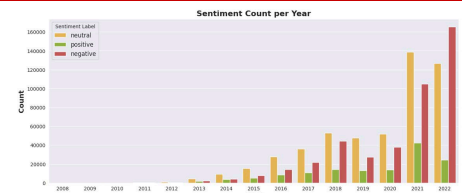


Fig. 2: Average Sentimental scores across different Subreddits from 2012 to 2022.

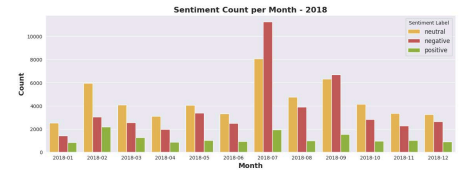


Fig. 3: Sentiment analysis for 2018, highlighting the monthly distribution.

reflecting the strategies used by news outlets to stimulate conversation. This, in turn, may result in aggressive or controversial expressions of opinion.

In addition to the structure of online platforms, the dynamics of individual interactions must also be considered. People with more extreme views may be more likely to engage in online discussions, potentially skewing overall sentiment. Conversely, those with moderate or neutral opinions may be deterred from participation due to the perceived hostility of the online environment. This complex interplay between individual behavior, platform design, and broader dynamics presents a rich field for further exploration, with implications for understanding how public sentiment is shaped and evolves in the digital age.

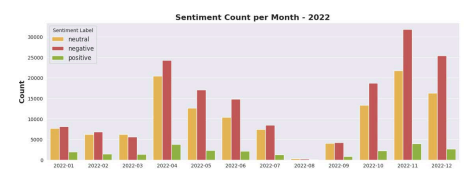


Fig. 4: Sentiment over the course of months in 2022, reflecting the Twitter acquisition's impact.

III-F. Conclusions on Public Opinion

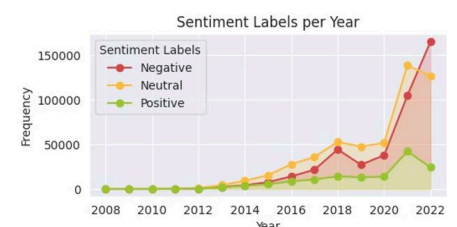


Fig. 5: Sentiment Frequency from 2008-2022, showing the evolution of public opinion.

This analysis over the past decade presents a complex and multifaceted picture of public opinion. As illustrated in Figures 5 and 6, the sentiment fluctuated significantly in response to various events, decisions, and controversies involving Mr. Musk and his companies.

The year-to-year and month-to-month variations emphasize how public opinion can be both volatile and transient.

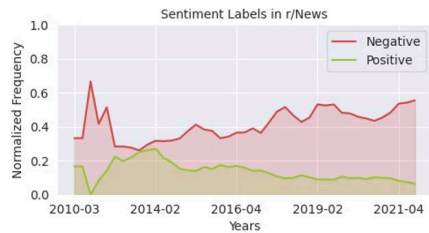


Fig. 6: Sentiment Frequency on r/News, a specific subreddit focus.

Influential factors include media coverage, the nature of the news, Mr. Musk’s personal behavior, and significant business decisions. For instance, the acquisition of Twitter in 2022 and the events of 2018 serve as illustrative examples of how occurrences can lead to sharp shifts in sentiment.

This also highlights the role of specific platforms, such as Reddit, in shaping and reflecting public opinion. The subreddits dedicated to Tesla Motors and SpaceX are particularly noteworthy, exhibiting mostly negative sentiment despite Musk’s achievements. This discrepancy may reveal underlying biases or preferences within specific online communities, offering a more nuanced understanding of how online discourse interacts with broader public sentiment.

DISCUSSION

The substantial proportion of neutral sentiments observed in the analysis might be indicative of the complexity in online communication, especially on platforms like Reddit, where

diplomatic discussions or conflicting opinions within a comment could lead to neutral classification. Moreover, the prevalence of neutrality could signify an increasing desire for balanced perspectives, even amidst polarized opinions on a controversial figure like Elon Musk. The detailed analysis of neutral sentiments highlights the intricate nature of online discourse and suggests a multifaceted understanding of public sentiment, shaped by factors such as individual behavior, platform design, media influence, and broader social dynamics.

The negative sentiment towards Elon Musk on selected subreddits may not only be related to his management of Tesla and SpaceX but also influenced by the online disinhibition effect and the unique dynamics of Reddit as a platform [8]. Musk’s leadership of these high-profile companies, coupled with his controversial statements on social media and tendency to make unfulfilled promises, has generated criticism [9]. The negative sentiment can be seen as a manifestation of interplay between personal conduct, business decisions, and the specific online environment, all of which resonate with the broader trends in online communication phenomena observed.

Elon Musk’s interaction with subreddits like r/memes and r/dogecoin represents a fascinating intersection between technology leadership and pop culture. His engagement has impacted markets and brought mainstream attention to cryptocurrencies. This dual role, both as an innovator and influencer, adds layers to public perception, making sentiment analysis particularly challenging and intriguing [10].

Besides the insights into Musk’s image, this study may contribute to a broader understanding of how influential figures are perceived in the digital age [11].

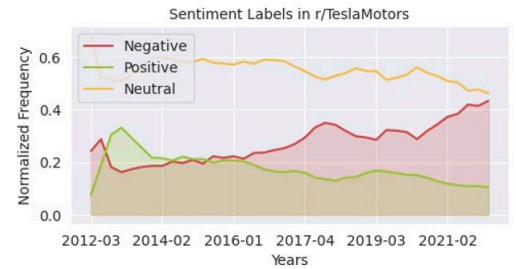


Fig. 7: Sentiment Frequency on r/TeslaMotors

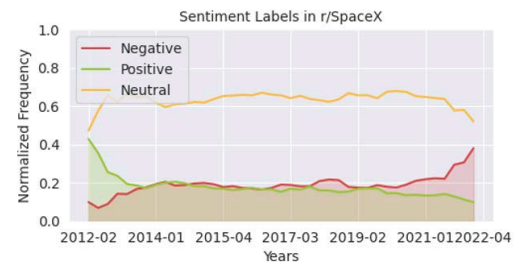


Fig. 8: Sentiment Frequency on r/SpaceX

The role of platforms, timing of statements, and the current socio-political environment might all contribute to fluctuations in sentiment. The complex interplay between these factors demands comprehensive and nuanced analysis tools, with sentiment analysis being a vital component.

The utilization of sentiment analysis in diverse fields like finance, as illustrated by Bloomberg’s use, signifies a growing trend of data-driven decision-making [12]. This study reinforces the need for robust,

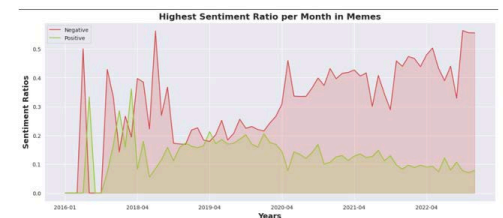


Fig. 9: Sentiment Frequency on r/memes

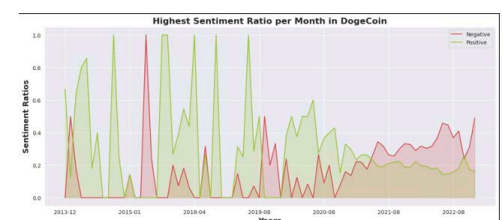


Fig. 10: Sentiment Frequency on r/dogecoin

transparent, and consistent methods for interpreting vast amounts of unstructured data.

The study underscores the importance of ethical considerations in sentiment analysis. The impact of influential figures on financial markets, the potential biases in models, and the implications of using algorithms to interpret human emotions are critical areas that warrant further exploration and discussion.

This offers a multi-faceted view of sentiment analysis applied to a dynamic subject. It not only investigates public opinion about a prominent figure but also delves into broader themes related to online communication, market dynamics, technology's role in shaping perception, and ethical considerations.

CONCLUSION

This study provides an insightful exploration into the popularity of Elon Musk over the years through the analysis of comments on selected subreddits. Utilizing state-of-the-art data mining and sentiment analysis techniques, significant fluctuations in sentiment were observed, reflecting not only the dynamic nature of public opinion but also in online communication. The play of neutral sentiments, media influence, and online platforms like Reddit has been found to contribute to the complex mixture of neutral, negative, and positive sentiments.

Our findings offer valuable insights into popular culture and the influencers of public sentiment, revealing patterns that might be indicative of broader "online communication phenomena". These results underscore the potential of sentiment analysis as a versatile tool for various applications, from

consumer behavior to informing business decisions. As technology progresses and data availability continues to expand, sentiment analysis stands poised to become a vital tool across a wide array of industries, transforming the way companies comprehend and engage with their customers.

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