Driving Public Opinion Through the Rise and Fall of Project Titan(1498 words)

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1 Introduction

In the rapidly evolving landscape of technology and mobility, the intersection of automotive innovation and consumer technology has become a focal point of interest and speculation. Harris et al. (2015) revealed that Apple Inc. was actively developing a self-driving car, known as "Project Titan", deep within Silicon Valley. This initiative saw the company exploring secure testing sites around the San Francisco Bay area, signifying a more advanced stage in the project than previously speculated. The anticipation around Project Titan was not just about a new product line; it was about the potential reshaping of the automotive industry through the lens of one of the world's most innovative companies. However, after nearly a decade of speculation, investment, and development, significant changes within the Project Titan team were observed in early 2019. McCarthy et al. (2019) reported a strategic shift within Apple's Project Titan team, with over 200 employees being reallocated or dismissed. This change underscored a broader strategic realignment and resource optimization within Apple, amidst evolving leadership dynamics.

This research paper seeks to explore the public's reaction to the rise and fall of Project Titan, aiming to understand how the anticipation, speculation, and eventual disappointment were reflected in social media sentiment. By analysing the shift in public sentiment before and after the cancellation announcement, this study provides insights into the impact of strategic corporate decisions on consumer expectations and the broader implications for tech companies venturing into new markets.

2 Research Question

How did public sentiment and topic discussions on Reddit evolve in light of Apple's Project Titan cancellation compared to the period before the announcement?

3 Method

3.1 Data

The data for this research were collected from Reddit using the Python Reddit API Wrapper (PRAW) package, focusing on posts titled 'Apple Cancels Work on Electric Car, Shifts Team to Generative AI', 'Apple Car Project Loses Senior Manager to Rivian', and 'Apple Targets Car Production by 2024 and Eyes "Next Level" Battery Technology'. The posts were sourced from specific subreddits: '/r/Technology', '/r/electricvehicles', '/r/investing', and '/r/apple'. The retrieval process involved using post IDs to collect attributes such as the author's name, comment text, date of posting and count of upvotes. To ensure comprehensive representation, the collection included 500 comments to capture a wide range of sentiments, prioritizing those with the highest number of votes. The dataset was divided into two distinct phases: the first capturing 250 comments made before the cancellation announcement up to February 26, 2024, and the second documenting 250 comments from the announcement day, February 27, 2024, onwards.

3.1.1 Prepocessing

Once the data is retrieved from Reddit, a series of steps are performed to clean and standardize the text within each comment. Initially, all text is converted to lowercase to ensure consistency. This is followed by the removal of punctuation, resulting in cleaner text devoid of non-essential characters. Subsequently, the text is broken down into individual words through a process known as tokenization. This step is crucial for a detailed understanding and analysis of the text at the

word level. The following phase involves filtering out stopwords—common words (”the”, ”is”, and ”in”) that typically lack significant meaning. By eliminating these, attention is directed towards more meaningful words that are expected to contribute to the sentiment and facilitating the subsequent construction of a dictionary and corpus required for LDA modeling. Below are sample records from the preprocessed dataset.

```
reddit_data.head()
```

	Author	Text	Date	Upvotes_count	cleaned_text
0	Wasaab	This is like the 1000th time (being dramatic) ...	2024-02-27 19:10:05	1703	like 1000th time dramatic hear apple canceling...
1	frownGuy12	I'm sure the heat pump engineers will do great...	2024-02-27 19:05:27	1063	' sure heat pump engineers great work next tok...
2	IAmA5starman	That title makes no sense, its like saying the...	2024-02-27 19:09:11	348	title makes sense like saying chefs hotel move...
3	stroll_on	If Apple was serious about EVs, they would jus...	2024-02-27 19:25:55	302	apple serious evs would buy rivian
4	throwmeaway1784	Bloomberg isn't homogeneous, Mark Gurman has a...	2024-02-27 19:29:00	197	bloomberg ' homogeneous mark gurman excellent ...

Figure 1: Dataset

3.2 Analysis

3.2.1 Topic Modeling with Latent Dirichlet Allocation (LDA)

The analysis was done by the utilization of the Latent Dirichlet Allocation (LDA) model, a probabilistic technique for topic modeling that posits comments are a mixture of topics and that topics are a mixture of words.

The LDA model was configured to identify ten distinct topics within the corpus, a decision guided by the need to balance granularity with coherence. Upon model training, the topics were extracted and characterized by their most significant terms, providing a thematic overview of the discourse surrounding Project Titan. The coherence score, a critical metric for evaluating topic models, was computed using the ‘CoherenceModel‘ function from ‘gensim‘ library. This score, which stood at 0.44, serves as a quantitative measure of the model's validity, indicating a moderate level of semantic consistency and interpretability among the top words in each topic.

```
topics_df = pd.DataFrame([[term for term, wt in topic] for topic in topics],
                         columns = ['Term'+str(i) for i in range(1, 21)],
                         index=['Topic '+str(t) for t in range(1, lda_model.num_topics+1)]).T
topics_df.head(10)
```

```
Topic      | Terms
-----------------------------------------------------------------------------------------------------------
Topic1     | apple, life, make, best, top, iphone, last, everything, products, wheels, know, battery, full, case, m
ax, screen, either, manufacturing, good, give
-----------------------------------------------------------------------------------------------------------
Topic2     | apple, car, would, business, product, see, people, makes, make, could, luxury, market, software, righ
t, tech, every, driving, said, phone, electric
-----------------------------------------------------------------------------------------------------------
Topic3     | deleted, point, honestly, pro, month, apple, know, days, wait, come, series, decade, isnt, hundreds, l
ol, probably, five, project, vision, throw
-----------------------------------------------------------------------------------------------------------
Topic4     | tesla, control, car, apple, us, theyre, imagine, insurance, might, would, cars, traditional, though, f
eatures, power, similar, working, anything, keep, battery
-----------------------------------------------------------------------------------------------------------
Topic5     | apple, car, like, get, battery, really, company, also, new, iphone, people, much, need, think, making,
something, industry, rivian, going, would
-----------------------------------------------------------------------------------------------------------
Topic6     | tesla, phones, model, want, likely, quality, thats, amazon, end, everyone, around, existing, experienc
e, feel, beat, none, guys, limited, play, talent
-----------------------------------------------------------------------------------------------------------
Topic7     | existing, luxury, yet, say, market, ecosystem, care, ford, ones, airpods, bad, another, mac, nda, lis
t, opinion, ago, music, ev, trying
-----------------------------------------------------------------------------------------------------------
Topic8     | supply, chain, find, two, problem, apple, rather, one, fucking, become, party, true, late, important,
ai, next, working, whatever, ways, months
-----------------------------------------------------------------------------------------------------------
Topic9     | without, year, auto, manufacturing, manufacturers, pretty, highly, apple, light, size, ev, get, absolu
tely, done, lot, ahead, buttons, makers, owns, partner
-----------------------------------------------------------------------------------------------------------
Topic10    | long, away, seems, lol, system, someone, consider, though, original, fact, sub, sure, harder, paid, tr
ying, guy, years, avoid, realize, check
-----------------------------------------------------------------------------------------------------------
```

Figure 2: Terms per Topic

Furthermore, to enhance interpretability, word clouds were generated for each topic using the 'WordCloud' function from the 'wordcloud' library. These visualizations graphically represent the terms' frequency within each topic, with larger font sizes denoting higher term significance. The word clouds provided a visual exploration of terms, enabling a more accessible identification of the predominant topics and their relative prominence.

Figure 3: Word Cloud for Terms per Topic

3.2.2 Sentiment Analysis with VADER

The sentiment analysis leverages the 'SentimentIntensityAnalyzer' module from the 'vaderSentiment' package, a tool that's really good at understanding the subtle emotions. VADER (Valence Aware Dictionary and sEntiment Reasoner) excels in understanding the subtle cues that contribute to sentiment intensity, such as punctuation, word capitalization, and syntactical patterns, thus providing a sophisticated analysis of the text's sentiment.

Each comment text within the dataset is evaluated using VADER, which assigns a compound sentiment score reflecting the overall sentiment polarity—positive, negative, and neutral. This scoring is contingent upon predefined thresholds: scores above 0.05 denote positive sentiment, scores below -0.05 indicate negative sentiment, and scores within this range suggest a neutral stance.

These compound scores, along with their sentiment, are appended to the original dataset, enriching it with a layer of sentiment analysis. Below is the modified dataset.

	Author	Text	Date	Upvotes_count	cleaned_text	Sentiment	Compound_Score
0	Wasaab	This is like the 1000th time (being dramatic) ...	2024-02-27 19:10:05	1703	like 1000th time dramatic hear apple canceling...	Positive	0.6597
1	frownGuy12	I'm sure the heat pump engineers will do great...	2024-02-27 19:05:27	1063	' sure heat pump engineers great work next tok...	Positive	0.7506
2	IAmA5starman	That title makes no sense, its like saying the...	2024-02-27 19:09:11	348	title makes sense like saying chefs hotel move...	Positive	0.4767
3	stroll_on	If Apple was serious about EVs, they would jus...	2024-02-27 19:25:55	302	apple serious evs would buy rivian	Negative	-0.0772
4	throwmeaway1784	Bloomberg isn't homogeneous, Mark Gurman has a...	2024-02-27 19:29:00	197	bloomberg ' homogeneous mark gurman excellent ...	Positive	0.5719

Figure 4: Dataset after sentiment analysis

4 Results

The sentiment distribution displayed in the bar chart indicates that the conversation surrounding Apple's Project Titan predominantly leans towards positive sentiments, with these comments being more frequent than negative and neutral ones. Negative sentiments are present to a lesser extent, suggesting some degree of criticism in public opinion. Neutral

sentiments, although the least common, still represent a notable fraction of the comments, pointing towards a segment of the audience that expresses indifferent views on the matter.

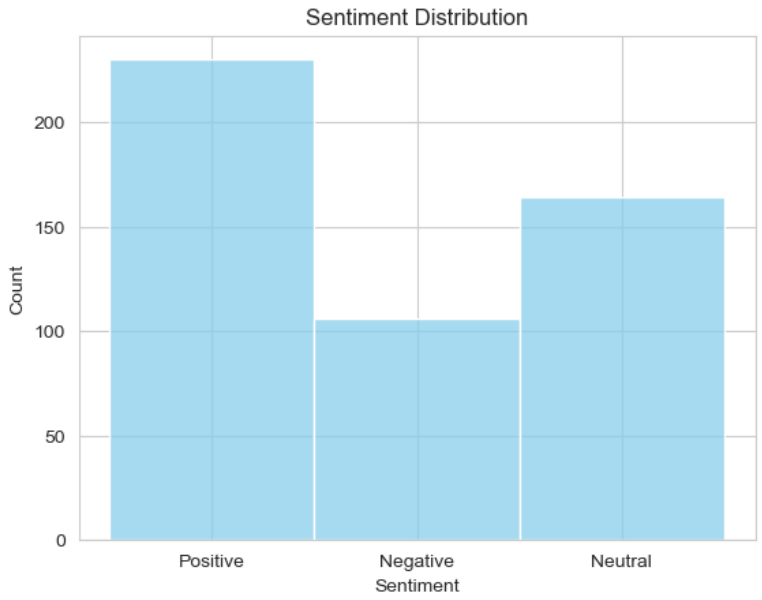

Figure 5: Sentiment Distribution

The line graph depicting sentiment over time suggests a dynamic evolution of public emotion. Positive sentiment shows significant fluctuations but maintains a strong presence throughout the observed period, indicative of ongoing optimism and support. Negative sentiment remains relatively low and stable, pointing to a consistent but smaller count of detractors. The neutral sentiment line, fairly flat, indicates a steady stream of impartial perspectives. Notably, there appears to be a sharp uptick in positive sentiment near the end of the timeline, possibly in response to the cancellation announcement. Conversely, a marked drop in negative sentiment occurs simultaneously, suggesting a potential shift in the public's critical stance.

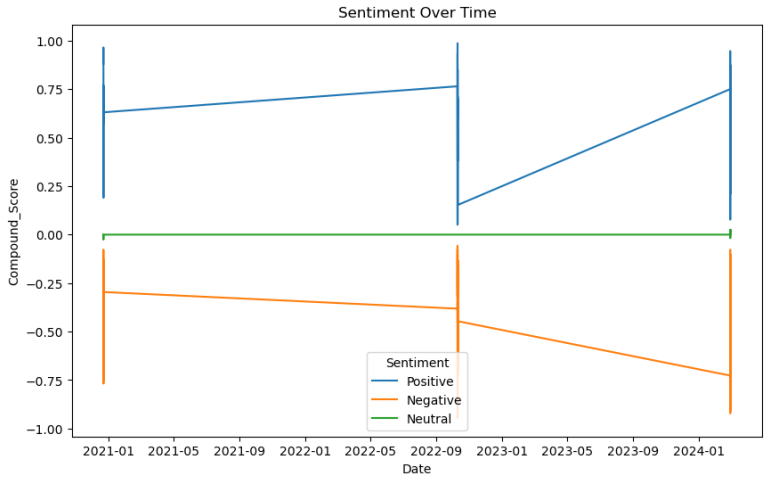

Figure 6: Sentiment over Time

The bar graphs reveal the top terms across ten different topics extracted from the comments. These visualizations show the weight of each term within its topic, giving a clear indication of the terms that define each topic's focus. The most prominent terms across topics are 'apple,' 'car,' 'battery,' and 'tesla,' which are pivotal within the discourse. The prominence of the term 'apple' across multiple topics underlines the centrality of the company within the conversation.

The presence of terms 'life,' 'make,' 'best,' and 'products' within the top-ranked terms for Topic 1 suggests a general discussion around the quality and impact of Apple's products. In contrast, the high weighting of 'car,' 'business,' 'product,' and 'market' in Topic 2 points towards a focus on Apple's potential market influence and product development.

Othe topics show a strong focus on specific aspects, manufacturing and supply chain issues in Topic 8, while others, in Topic 5, center more on product features and user experience. Topic 7's emphasis on 'luxury,' 'market,' and 'ecosystem'

could be reflecting discussions around the positioning of Apple's products in the high-end market segment.

The varied terms across topics suggest diverse areas of interest and concern among the public and stakeholders, from technical aspects of manufacturing and supply chain logistics to broader business strategy considerations and market positioning.

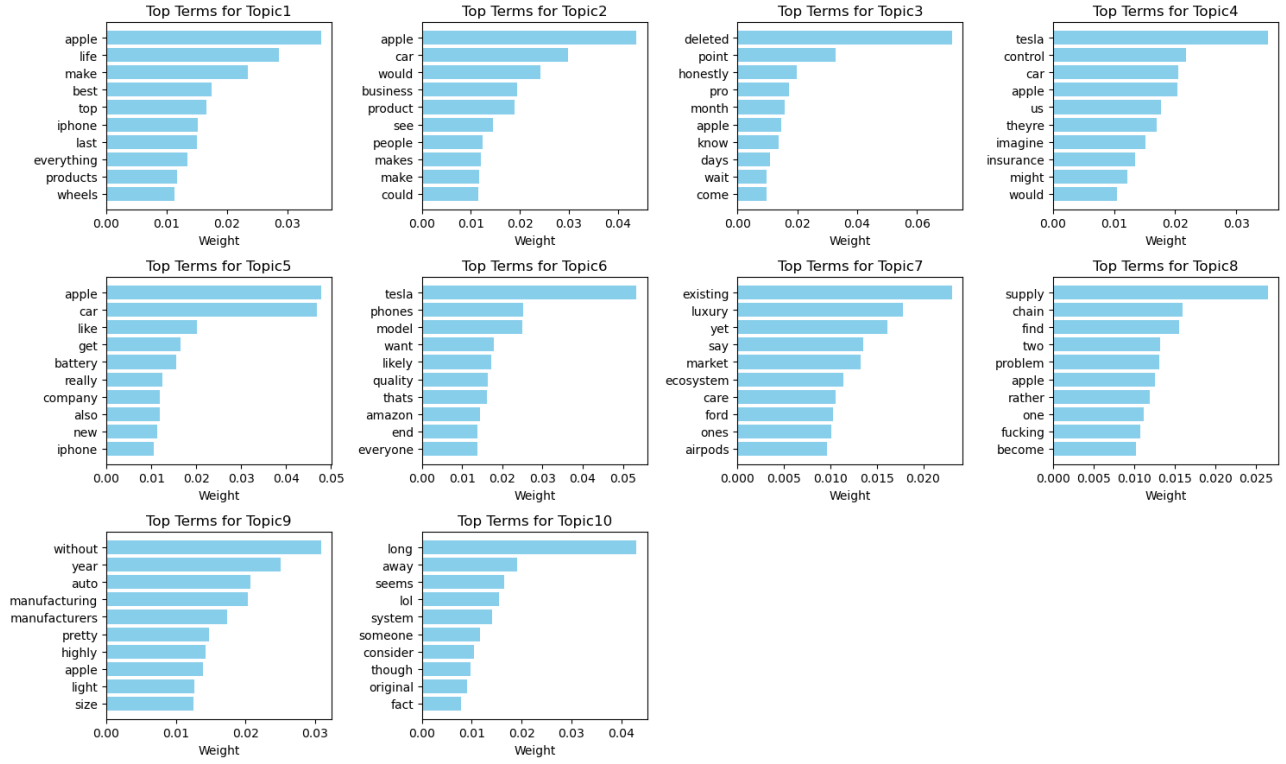

Figure 7: Top Terms for each topic

5 Conclusion and Limitations

The research conducted offers valuable insights into public sentiment surrounding Apple's Project Titan, as reflected in Reddit discussions. Through the application of LDA topic modeling, key thematic areas have been identified that underpin the discourse around Apple's innovation, market strategy, and product development. The sentiment analysis reveals a predominantly positive outlook, indicating an overall optimistic perception of Apple's foray into the automotive industry. This study's findings contribute to a better understanding of consumer expectations and the broader implications of strategic decisions made by technology companies venturing into new markets. It also highlights the public reaction to such high-profile corporate initiatives and their subsequent cancellations.

While the study provides comprehensive insights, it is not without limitations. The analysis relies on data from Reddit, which, while substantial, represents only a fraction of global online discourse and may not fully capture the diversity of global perspectives. Additionally, the sentiment analysis tool used, VADER, is optimized for English-language text, which may not accurately reflect sentiment in multilingual discussions. The coherence score of the LDA model, though moderate, suggests there is room for improving the model's accuracy and the granularity of the topics extracted.

6 References

1. Harris, M., 2015. Documents confirm Apple is building self-driving car. The Guardian, 14(8), pp.1-3.
2. Mccarthy, S., 2019. Apple dismisses over 200 staff from autonomous vehicle group. UWIRE Text, pp.1-1.