

TWITTER SENTIMENT ANALYSIS & EFFECTS ON STOCK PRICE OF TESLA COMPANY

*A Practice School Report submitted to
Manipal Academy of Higher Education
in partial fulfilment of the requirement for the award of the degree of*

BACHELOR OF TECHNOLOGY

in

Computer Science & Engineering

Submitted by

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Under the guidance of

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MANIPAL
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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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CERTIFICATE

This is to certify that the project titled **TWITTER SENTIMENT ANALYSIS AND EFFECTS ON STOCK MARKET OF TESLA COMPANY** is a record of the bonafide work done by **DIYA PATEL** (*Reg. No. 190905136*) submitted in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology (B.Tech.) in **COMPUTER SCIENCE & ENGINEERING** of Manipal Institute of Technology, Manipal, Karnataka, (A Constituent Institute of Manipal Academy of Higher Education), during the academic year 2022-2023.

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Project / Internship Offer Letter



December 22, 2022

Re: Internship Offer

Diya Patel

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Email ID [REDACTED]

Mob. No. [REDACTED]

Dear Diya

Congratulations!

We are pleased to offer you a four-month internship program at our organization. Please find the details of the offer below:

- Position: Intern [REDACTED]
- Start Date: [REDACTED]
- End Date: [REDACTED]
- Workday: [REDACTED]
- Working Hours: [REDACTED]
- Stipend: [REDACTED]

During your internship, you may have access to confidential business information belonging to the company. By accepting this offer, you acknowledge that you must keep all of this information strictly confidential and refrain from using it for your own purposes or from disclosing it to anyone outside the company.

Should you have any questions, please feel free to contact us in the HR department.

Yours Truly

[REDACTED]
Vice President- HR



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Project Completion Letter



TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Diya Patel** has completed a 4-month Internship Program in the Data Analytics Department at **Online PSB Loans Limited**. The Internship started on [REDACTED]

Online PSB Loans Limited is India's largest lending Fintech company incorporated with an objective to provide advanced technology-based financial innovations and solutions.

During the period of Internship, Diya's conduct and performance were found to be satisfactory. We wish her good luck in his future endeavors.

Yours Truly,

Authorized Signatory



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I am deeply grateful to the individuals who contributed significantly to the successful completion of my project. Their unwavering support and invaluable guidance were instrumental in shaping my work and making it a reality.

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I would also like to express my sincere gratitude to the company personnel and my team members who offered their invaluable insights and suggestions. Their contributions helped me shape my work and refine my ideas.

I extend my heartfelt appreciation to my internal guide, whose support and advice were invaluable to me throughout the project. Their constructive feedback helped me refine my work and elevate its quality.

I cannot overemphasize the role of these individuals in my project's success. Their guidance and unwavering support made a tremendous impact, and I am deeply grateful for their contributions. Thank you all for being part of my journey and for making this project a reality. Your support and guidance will always be cherished.

ABSTRACT

Twitter sentiment analysis has become increasingly popular in recent years due to the growing importance of social media as a source of information. It has been demonstrated that sentiment analysis of tweets can have a significant impact on stock market prices, making it a valuable tool for investors. This project aims to perform sentiment analysis on tweets related to Tesla and investigate its effects on the company's stock market.

To achieve this objective, we collected Tesla-related tweets using Twitter's API and performed sentiment analysis using natural language processing techniques. We also collected stock market data for Tesla from Yahoo Finance and analysed the correlation between sentiment scores of tweets and stock market prices.

The analysis revealed a significant correlation between the sentiment scores of tweets and stock market prices of Tesla. Positive sentiment scores had a positive impact on stock prices, while negative sentiment scores had a negative impact. We also found that sentiment analysis of tweets can be used as a predictive tool for forecasting the stock market prices of Tesla.

The results of this study demonstrate the importance of sentiment analysis on social media platforms such as Twitter for predicting stock market prices. It can be used as a valuable tool for investors to make informed decisions. Moreover, the findings contribute to the growing field of natural language processing and machine learning, highlighting the potential applications of sentiment analysis in finance. The future research can expand the analysis to other companies and industries. These data visualizations using Tableau illustrate the correlation between sentiment scores of tweets and stock market prices of Tesla. The project highlights the importance of utilizing social media platforms for analysing the sentiment of users and its impact on the stock market. Overall, this study demonstrates the potential of sentiment analysis in predicting stock market prices and provides valuable insights for investors. The software tools/packages used in this project include Python, snsrape, nltk, pandas, and Tableau.)

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CHAPTER 1

INTRODUCTION

1.1 Introduction:

This chapter will provide an overview of the Twitter Sentiment Analysis project and its effects on the stock market of Tesla company. The chapter will cover the introduction, present-day scenario, motivation, shortcomings in previous work, importance of the work, uniqueness of the methodology, significance of possible end results, objectives of the work, and target specifications.

1.2 Introduction to the area of work:

The area of work for this project encompasses the intersection of sentiment analysis, social media, and the stock market. With the advent of social media, there has been a growing interest in utilizing user-generated content to extract valuable insights and opinions. Sentiment analysis, a subfield of NLP, is a powerful technique that allows us to analyse the attitudes, opinions, and emotions expressed in textual data. Social media platforms like Twitter have become a valuable source of real-time data for sentiment analysis.

The stock market is highly influenced by market sentiment, which refers to the overall mood or attitude of investors towards the market. Market sentiment can be influenced by various factors, including news, events, and opinions expressed on social media platforms. By analysing the sentiment of Twitter data related to a particular company, we can gain insights into customer perception, which can potentially impact the stock market trends of that company.

The intersection of sentiment analysis, social media, and the stock market has garnered significant attention in recent years. Companies and investors are increasingly leveraging sentiment analysis to gain insights into customer perception and market dynamics. This project aims to contribute to this growing field of research by analysing the sentiment of Twitter data related to Tesla and predicting its stock market trends.

1.3 Brief present-day scenario with regard to the work area:

In recent years, sentiment analysis has become an increasingly popular technique for businesses and investors to gain insights into customer perception and market dynamics. Social media platforms like Twitter provide a wealth of real-time data that can be used to analyse market sentiment. The stock market is highly influenced by

market sentiment, and the ability to predict stock market trends based on sentiment analysis is a valuable tool for investors.

The present-day scenario of sentiment analysis, social media, and the stock market is one of rapid growth and innovation. Advancements in NLP and data visualization techniques have made it easier to analyse large volumes of textual data and extract valuable insights. Furthermore, the increasing availability of real-time data from social media platforms has created new opportunities for businesses and investors to gain a competitive edge in the market.

The use of social media platforms such as Twitter has become increasingly popular in recent years. Companies are now leveraging the power of social media to engage with their customers and potential customers. Twitter is one such platform that has been used extensively by companies to gather feedback from their customers. The impact of Twitter sentiment on the stock market has been a topic of research in recent years.

In this context, this project aims to contribute to this growing field of research by analysing the sentiment of Twitter data related to Tesla and predicting its stock market trends. The results of this project can potentially provide valuable insights into the impact of social media on the stock market trends of a particular company and can be applied to other companies and industries as well.

1.4 Motivation to do the project work:

The motivation for this project stems from the increasing importance of sentiment analysis in today's business and investment landscape. With the rise of social media, companies and investors are increasingly turning to sentiment analysis to gain insights into customer perception and market trends. Sentiment analysis allows businesses to monitor brand sentiment, identify customer pain points, and develop effective marketing strategies. Similarly, investors can use sentiment analysis to predict market trends and make more informed investment decisions.

In the case of Tesla, sentiment analysis is particularly relevant given the company's strong social media presence and the influence of its CEO, Elon Musk, on social media platforms like Twitter. Understanding the sentiment of Twitter data related to Tesla can provide valuable insights into customer perception and market dynamics. Furthermore, predicting Tesla's stock market trends based on sentiment analysis can potentially provide a competitive edge to investors.

Thus, the motivation behind this project is to explore the potential of sentiment analysis in predicting stock market trends and to provide valuable insights into the impact of social media on the stock market trends of Tesla.

1.5 Shortcomings in the previous work/reference paper:

Previous work has focused on the analysis of Twitter sentiment and its impact on the stock market of various companies. However, the existing studies have not specifically focused on the impact of Twitter sentiment on the stock market of specifically Tesla as company or any product/model of Tesla. This project aims to fill this gap in the existing literature.

1.6 Brief importance of the work in the present context:

The present context highlights the importance of this project in several ways:

- Market Analysis and Decision-making: In today's dynamic and fast-paced market, understanding customer sentiment and market trends is crucial for businesses and investors. This project's focus on sentiment analysis and stock market prediction provides a valuable tool for market analysis and decision-making. By leveraging sentiment analysis on social media data, companies and investors can gain insights into customer perception and make informed decisions to stay ahead in the competitive landscape.
- Social Media Influence: Social media platforms have become powerful sources of information and communication. They shape public opinion, influence consumer behaviour, and impact stock market trends. The work carried out in this project, which focuses on analysing sentiment from Twitter data, recognizes the influence of social media on market dynamics. By understanding and leveraging sentiment analysis techniques, businesses and investors can tap into this valuable source of information to gain a competitive advantage.
- Real-time Insights: The project's utilization of real-time data from Twitter allows for up-to-date and timely insights into customer sentiment. In today's rapidly changing market environment, having access to real-time insights is crucial for businesses to adapt quickly and make agile decisions. By analysing sentiment in real-time, businesses and investors can capture emerging trends, mitigate risks, and capitalize on market opportunities.
- Technological Advancements: This project aligns with the current advancements in NLP techniques, data visualization tools like Tableau, and sentiment analysis algorithms. It leverages these technological advancements to provide a

comprehensive analysis of sentiment and its impact on stock market trends. The work serves as an example of how cutting-edge technologies can be applied to extract valuable insights from social media data for business and investment purposes.

In summary, this project's importance lies in its ability to provide market analysis, leverage social media influence, offer real-time insights, and align with technological advancements. By understanding and predicting sentiment-related stock market trends, businesses and investors can make data-driven decisions and stay competitive in the present market context.

1.7 Uniqueness of the methodology that will be adopted:

The methodology adopted in this project encompasses several unique aspects that set it apart from existing approaches:

1. Integration of NLP Techniques: This project incorporates Natural Language Processing (NLP) techniques to perform sentiment analysis on Twitter data related to Tesla. By utilizing NLP algorithms, such as VaderSentimentAnalyzer, we can extract sentiment information from textual data and classify tweets as positive, negative, or neutral. This integration of NLP techniques allows for a detailed analysis of sentiment and its impact on stock market trends.
2. Use of Tableau for Data Visualization: The project employs Tableau, a powerful data visualization tool, to present the sentiment analysis results in a visually compelling and intuitive manner. By utilizing Tableau's interactive dashboards and graphs, we can effectively communicate the sentiment distribution and trends derived from Twitter data. This unique aspect enhances the project's ability to convey complex sentiment analysis findings to stakeholders and decision-makers.
3. Focus on Tesla and Western Countries: This project specifically targets Twitter data related to Tesla and focuses on analysing sentiment within Western countries where Tesla has a significant presence. By narrowing down the scope to a specific company and geographical region, the analysis becomes more focused and tailored to the context of Tesla's market and customer sentiment.
4. Consideration of External Factors: The project acknowledges the impact of external factors, such as the COVID-19 pandemic, on the stock market trends of Tesla. By considering these external factors during the analysis, we can provide a more comprehensive understanding of the relationship between sentiment analysis

and stock market trends, accounting for the potential deviations caused by such factors.

5. Stock Market Trend Prediction: The unique aspect of this methodology lies in its ability to predict stock market trends based on the sentiment analysis results. By correlating the sentiment analysis findings with historical stock market data of Tesla, we can make predictions about the future stock market trends. This forecasting aspect adds a valuable dimension to the project, enabling stakeholders to make informed investment decisions based on sentiment analysis insights.

The combination of these unique elements in the methodology sets this project apart, allowing for a comprehensive analysis of sentiment, effective data visualization, consideration of external factors, and stock market trend prediction.

1.8 Significance of the possible end result:

The possible end result of this project holds significant importance in several ways:

1. Enhanced Decision-making: The sentiment analysis results, and stock market trend predictions obtained through this project can provide valuable insights to businesses and investors. Understanding the sentiment of Twitter users towards Tesla and its correlation with stock market trends can aid in making more informed investment decisions and developing effective market strategies. By leveraging these insights, stakeholders can potentially gain a competitive edge and optimize their decision-making process.
2. Customer Perception and Brand Management: The sentiment analysis of Twitter data related to Tesla enables a deeper understanding of customer perception and sentiment towards the brand. This information can assist Tesla and other companies in monitoring and managing their brand reputation, identifying customer pain points, and tailoring their products and services to meet customer expectations. The end result of this project can provide actionable insights for brand management and customer relationship management strategies.
3. Financial Market Insights: The stock market trend predictions derived from sentiment analysis can provide financial market insights to investors, traders, and financial analysts. Understanding the impact of sentiment on stock market movements can help in identifying potential investment opportunities, managing risks, and optimizing portfolio strategies. The end result of this project can serve as a valuable tool for financial market analysis and decision-making.

4. Advancement of Research in Sentiment Analysis: The end result of this project contributes to the broader research in sentiment analysis, particularly in the context of social media and its impact on the stock market. By exploring the relationship between Twitter sentiment and stock market trends, this project adds to the existing body of knowledge and can serve as a foundation for further research in this domain.
5. Practical Application in Other Industries: While this project focuses on Tesla, the methodology and insights gained can be applied to other companies and industries as well. The significance of sentiment analysis and its impact on stock market trends extends beyond Tesla, making the end result of this project applicable to a wider range of businesses and investors.

In summary, the possible end result of this project holds significant significance in terms of decision-making, brand management, financial market insights, advancement of research, and practical application in other industries. It has the potential to provide actionable insights and contribute to the understanding of sentiment analysis and its implications for stock market trends.

1.9 Objective of the work:

The objective of this work is to analyse the sentiment of Twitter data related to Tesla using Natural Language Processing (NLP) techniques and predict the stock market trends of Tesla based on the sentiment analysis results. The specific objectives are as follows:

1. **Conduct Sentiment Analysis**: Perform sentiment analysis on Twitter data related to Tesla using NLP techniques. Classify the tweets as positive, negative, or neutral based on the expressed opinions, attitudes, and emotions. This analysis will provide insights into the overall sentiment of Twitter users towards Tesla.
2. **Visualize Sentiment Analysis Results**: Utilize data visualization techniques, specifically using Tableau, to present the sentiment analysis results in a graphical and tabular format. Visualizing the sentiment distribution and trends will enhance the understanding and interpretation of the sentiment analysis findings.
3. **Predict Stock Market Trends**: Correlate the sentiment analysis results with historical stock market data of Tesla to predict the stock market trends for the specified timeframe, specifically focusing on the year 2021. This prediction will provide valuable insights into the potential impact of sentiment on the stock market performance of Tesla.

4. **Evaluate Accuracy and Deviations:** Compare the predicted stock market trends with the actual historical data of Tesla for the year 2021. Assess the accuracy of the methodology and identify any deviations or discrepancies. Consider external factors, such as the COVID-19 pandemic, that may have influenced the stock market trends, and justify any deviations observed.
5. **Provide Recommendations and Future Scope:** Based on the findings, draw conclusions about the relationship between sentiment analysis and stock market trends. Provide recommendations for businesses, investors, and researchers on leveraging sentiment analysis insights. Discuss the future scope of work, including potential improvements to the methodology, consideration of additional factors, and applicability to other industries.

By achieving these objectives, this work aims to contribute to the understanding of sentiment analysis and its impact on stock market trends. It provides valuable insights for decision-making, brand management, and financial market analysis, while also opening avenues for further research in the field of sentiment analysis and its application to other companies and industries.

1.10 Target Specifications:

The end result of this project will provide valuable insights into the impact of Twitter sentiment on the stock market of Tesla. This analysis can help investors make informed decisions about their investments in Tesla. Furthermore, this work can be extended to other companies to analyse the impact of Twitter sentiment help deliver a comprehensive analysis of sentiment, accurate stock market trend predictions, and valuable insights for stakeholders in decision-making, brand management, and financial market analysis.

1.11 Project Work schedule:

| | |
|---|---|
| 2 nd Jan'23 – 31 st Jan'23 | Training |
| 1 st Feb'23 to 15 th Feb'23 | Training + Project Research Research on web scrapping, tools (python library to use), trying to prepare a pipeline for the project |
| 16 th Feb'23 to 2 nd Mar'23 | Web scrapping of tweets using different ways to check efficiency and how clean the data is when mined |
| 3 rd Mar'23 to 17 th Mar'23 | Understanding the market of tesla with Yahoo Finance data and start of cleaning the data with python and Tableau Prep(if |

| | |
|--|---|
| | required). |
| 18 th Mar'23 to 1 st April'23 {Mid-term Viva: 23 rd Mar'23} | Trying and testing data visualization of Tesla stock market data with Tableau Desktop. |
| 2 nd April'23 to 17 th April'23 | Adjust Holidays and Off-days in stock market data with Python, and data visualisation and forecasting. |
| 18 th April'23 to 2 nd May'23 {Internship ends on 2 nd May'23} | Data visualization, sentiment analysis and drawing insights for stock market prediction from forecasts and sentiment visualization. |

Table 1: Project work schedule

1.12 Organization of the project report (chapter wise):

- Chapter 2: Background Theory/Literature Review
- Chapter 3: Methodology
- Chapter 4: Result Analysis and
- Chapter 5: Conclusion and Future Scope

CHAPTER 2

BACKGROUND THEORY / LITERATURE REVIEW

2.1 Introduction:

This chapter will provide an overview of the background theory and literature review related to the project "Twitter Sentiment Analysis and effects on Stock Market of Tesla company." The chapter will cover the introduction, introduction to the project title, present state/recent developments in the work area, brief background theory, literature survey, summarized outcome of the literature review, theoretical discussions, general analysis, and conclusions.

2.2 Introduction to the project title:

The aim of this project is to analyse the sentiment of Twitter data related to Tesla using Natural Language Processing (NLP) techniques and to predict the stock market trends of Tesla based on the sentiment analysis results. Twitter has become a valuable source of real-time opinions and feedback, making it an ideal platform for sentiment analysis. By understanding the sentiment expressed by users on Twitter towards Tesla, we can gain insights into customer perception, which can have a significant impact on the stock market.

Tesla, a prominent player in the technology and electric vehicle industry, has garnered immense attention and has a large following on social media platforms. The sentiment of Twitter users towards Tesla is likely to reflect their opinions on Tesla's products, innovations, and CEO Elon Musk's influence on social media.

To achieve our objective, we will employ NLP techniques to analyse the sentiment of Twitter data related to Tesla. We will use sentiment analysis algorithms, such as VaderSentimentAnalyzer, to classify the tweets as positive, negative, or neutral based on the expressed opinions, attitudes, and emotions. The sentiment analysis results will then be visualized using Tableau, a powerful data visualization tool, to provide a clear and comprehensive understanding of the sentiment distribution.

Furthermore, we will leverage the sentiment analysis results to predict the stock market trends of Tesla in 2021. By correlating the sentiment of Twitter data with the historical stock market data of Tesla, we can identify potential associations and patterns. This analysis will be crucial for investors and stakeholders, providing them with insights to make informed decisions.

It is important to consider potential deviations from the expected results due to external factors, limitations of sentiment analysis techniques, market volatility, and data quality. These factors can influence the accuracy and reliability of the sentiment analysis and subsequent stock market trend prediction.

By conducting this project, we aim to contribute to the growing body of research on the application of sentiment analysis in stock market analysis and provide valuable insights into customer sentiment towards Tesla. The findings of this study can be beneficial for investors, financial analysts, and companies like Tesla to better understand customer perception and market dynamics in the technology industry.

2.3 Literature Review:

a. Present state/recent developments in the work area:

Twitter sentiment analysis has gained a lot of attention in recent years due to its potential to predict stock market trends. Several studies have been conducted to analyse the impact of Twitter sentiment on the stock market of various companies. However, the existing studies have not specifically focused on the impact of Twitter sentiment on the stock market of Tesla.

b. Brief background theory:

The background theory of this project involves the use of Natural Language Processing (NLP) techniques to analyse the sentiment of tweets related to Tesla. The sentiment analysis can be combined with machine learning algorithms to predict the stock market trends of Tesla.

c. Literature Survey:

- A literature survey was conducted to identify existing research on the impact of Twitter sentiment on the stock market. Several studies have been conducted on this topic, and the majority of them have reported a positive correlation between Twitter sentiment and stock market trends. However, the existing studies have not specifically focused on the impact of Twitter sentiment on the stock market of Tesla.
- The survey on Twitter Sentiment Analysis explores various approaches and techniques used to analyse sentiment on Twitter. The study categorizes the approaches into three main groups: lexicon-based, machine learning-based, and hybrid-based. The survey also discusses the challenges and limitations of these approaches and suggests areas for further research.
- In the lexicon-based approach, sentiment analysis is performed by matching the words in the tweet to a pre-defined sentiment lexicon. The

machine learning-based approach involves training a model on a large dataset of annotated tweets to predict sentiment. The hybrid-based approach combines both of these methods.

- The survey highlights the strengths and weaknesses of each approach and concludes that no single approach is superior to the others. The authors also suggest that the performance of sentiment analysis models can be improved by using techniques such as data augmentation, feature engineering, and ensemble learning.
- The paper also discusses the potential applications of sentiment analysis on Twitter, including predicting stock prices, analysing political sentiment, and monitoring public opinion towards brands and products.
- Regarding the effect of sentiment analysis on the stock market, the survey found that sentiment analysis can be used as a tool for predicting stock prices. By analysing the sentiment of tweets related to a particular company or industry, investors and traders can make more informed decisions about buying or selling stocks. However, the survey also notes that there are limitations to the effectiveness of sentiment analysis in predicting stock prices, and it should not be relied upon as the sole factor in making investment decisions.
- In conclusion, the paper provides a comprehensive overview of the various approaches used for sentiment analysis on Twitter and their potential applications, while also highlighting the challenges and limitations of these approaches.

2.4 Summarized outcome of the literature review:

The literature review summarized in the research paper provides an overview of the state-of-the-art sentiment analysis approaches used for Twitter data. The review found that sentiment analysis can be useful in a variety of applications, such as predicting stock prices, analysing political sentiment, and monitoring public opinion towards brands and products. The authors categorize the approaches into three groups: lexicon-based, machine learning-based, and hybrid-based. The review also discusses the strengths and limitations of these approaches and suggests future research directions for improving the accuracy and effectiveness of sentiment analysis models. Overall, the literature review provides valuable insights into the current research on Twitter sentiment analysis and its potential applications.

2.5 Theoretical discussions:

The theoretical discussions related to this study could include the following:

- Sentiment Analysis: Sentiment analysis is a branch of Natural Language Processing (NLP) that involves the use of computational techniques to analyse and classify opinions, attitudes, and emotions expressed in text. The study utilized sentiment analysis to analyse Twitter data related to Tesla and predict stock market trends based on customer sentiment. Further research could explore the theoretical underpinnings of sentiment analysis and its applications in different domains.
- Efficient Market Hypothesis (EMH): The Efficient Market Hypothesis suggests that financial markets are efficient and all available information is already reflected in the current stock prices. The study used sentiment analysis to predict stock market trends of Tesla based on customer sentiment. The theoretical discussion could explore the limitations of EMH and how sentiment analysis could provide additional insights into market trends.
- Social Media and Customer Sentiment: Social media platforms have become an important source of customer feedback and sentiment analysis can provide valuable insights into customer sentiment towards products, services, and brands. Theoretical discussions could explore the role of social media in shaping customer sentiment and how sentiment analysis could be used to improve customer engagement and loyalty.
- Limitations of Sentiment Analysis: Sentiment analysis is not a perfect technique and has its limitations. Theoretical discussions could explore the challenges of sentiment analysis, such as data quality, language nuances, and the subjectivity of opinions. Further research could explore how these challenges could be addressed to improve the accuracy and reliability of sentiment analysis.

Overall, the theoretical discussions related to this study could provide valuable insights into the theoretical underpinnings of sentiment analysis and its applications in finance, marketing, and customer engagement.

2.6 General analysis:

To provide a more comprehensive analysis, a literature survey was conducted to gather relevant background theory and previous studies related to sentiment analysis and its impact on the stock market trends. The following are some of the key findings of the literature survey:

- Sentiment Analysis: Sentiment analysis is a popular NLP technique that has been widely used to analyse customer feedback and opinions on social media platforms

such as Twitter, Facebook, and Instagram. Sentiment analysis involves the use of machine learning algorithms to classify text as positive, negative, or neutral based on the expressed opinions, attitudes, and emotions.

- Impact of Sentiment Analysis on Stock Market Trends: Previous studies have shown that sentiment analysis can be used to predict stock market trends by analysing customer sentiment towards specific companies, products, and services. These studies have demonstrated that sentiment analysis can provide valuable insights into customer behaviour and preferences, which can be used to improve investment decisions and market strategies.
- Use of Tableau for Data Visualization: Tableau is a popular data visualization tool that can be used to create interactive dashboards and graphs to represent data in an intuitive and easy-to-understand manner. Tableau can be used to analyse and visualize the sentiment analysis results obtained from social media platforms such as Twitter.
- Limitations of Sentiment Analysis: Despite its usefulness, sentiment analysis has its limitations. One of the major limitations is the accuracy of the sentiment classification, which can be affected by the language nuances, sarcasm, and irony. Additionally, sentiment analysis does not consider external factors such as political instability, economic policies, and natural disasters that can impact the stock market trends.

Overall, the literature survey highlights the importance of sentiment analysis in predicting stock market trends and its potential impact on investment decisions and market strategies. The survey also highlights the importance of using data visualization tools such as Tableau to represent the sentiment analysis results in a more intuitive and easy-to-understand manner.

2.7 Conclusions:

The literature review revealed that the impact of Twitter sentiment on the stock market of Tesla has not been extensively studied. The proposed project aims to fill this gap in the existing literature by analysing the impact of Twitter sentiment on the stock market of Tesla. The project will use NLP techniques and Tableau to analyse the sentiment of tweets related to Tesla and predict the stock market trends of Tesla.

CHAPTER 3

METHODOLOGY

3.1 Introduction:

This chapter will discuss the methodology used in the project "Twitter Sentiment Analysis and effects on Stock Market of Tesla company." The chapter will cover the detailed methodology, assumptions made, design and modelling, block diagrams, module specifications, justification for the modules, tools used, detailed specification of various components and measuring devices, preliminary result analysis if any, and conclusions.

3.2 Methodology:

The proposed methodology for this project involves the following steps:

3.2.1 Data Collection: The first step involves collecting relevant data from Twitter, which includes tweets related to Tesla company. The data can be collected using the Twitter API or other third-party tools that allow for data extraction from Twitter. The collected data should include relevant information such as tweet text, date and time of tweet, and user information.

- Here, I have used a third-party tool, a python library snsrape (import *snsrape.modules.twitter*), retrieve the tweets.
- Importing the required libraries:

```
import pandas as pd
import numpy as np
import snsrape.modules.twitter as sntwitter
import datetime
from tqdm.notebook import tqdm_notebook
```

Fig 1 : Web-Scrapping Libraries

- Taking User Input: Query text, username, since, until, count, retweet, replies, etc.

Taking User Input

```
In [2]: 1 text = input('Enter query text to be matched (or leave it blank by pressing enter)')
2 username = input('Enter specific username(s) from a twitter account without @ (or leave it blank by pressing enter): ')
3 since = input('Enter startdate in this format yyyy-mm-dd (or leave it blank by pressing enter): ')
4 until = input('Enter enddate in this format yyyy-mm-dd (or leave it blank by pressing enter): ')
5 count = int(input('Enter max number of tweets or enter -1 to retrieve all possible tweets: '))
6 retweet = input('Exclude Retweets? (y/n): ')
7 replies = input('Exclude Replies? (y/n): ')
```

```
Enter query text to be matched (or leave it blank by pressing enter)#tesla
Enter specific username(s) from a twitter account without @ (or leave it blank by pressing enter):
Enter startdate in this format yyyy-mm-dd (or leave it blank by pressing enter): 2018-01-01
Enter enddate in this format yyyy-mm-dd (or leave it blank by pressing enter): 2020-12-31
Enter max number of tweets or enter -1 to retrieve all possible tweets: -1
Exclude Retweets? (y/n): y
Exclude Replies? (y/n): y
```

Fig 2 : User Input

- Tweets that contain regarding tesla and its different model cars can be added to (for specification, if required). We add in the search query as for example, (#Tesla OR #ModelY OR #Elon Musk and so on...)
- This will get us all the tweets regarding Tesla. Since, this is a sentiment analysis project we will just retrieve tweets in a specific time period, otherwise the data can be huge and would be difficult to handle.
- On scraping we can get the following fields:
 - url: str
 - date: datetime.datetime
 - rawContent: str
 - renderedContent: str
 - id: int
 - user: 'User'
 - replyCount: int
 - retweetCount: int
 - likeCount: int
 - quoteCount: int
 - conversationId: int
 - lang: str
 - source: str
 - sourceUrl: typing.Optional[str] = None
 - sourceLabel: typing.Optional[str] = None
 - links: typing.Optional[typing.List["TextLink"]] = None
 - media: typing.Optional[typing.List["Medium"]] = None
 - retweetedTweet: typing.Optional["Tweet"] = None
 - quotedTweet: typing.Optional["Tweet"] = None
 - inReplyToTweetId: typing.Optional[int] = None
 - inReplyToUser: typing.Optional["User"] = None
 - mentionedUsers: typing.Optional[typing.List["User"]] = None
 - coordinates: typing.Optional["Coordinates"] = None
 - place: typing.Optional["Place"] = None
 - hashtags: typing.Optional[typing.List[str]] = None
 - cashtags: typing.Optional[typing.List[str]] = None
 - card: typing.Optional["Card"] = None

Fig 3 : Types of Fields when twitter scrapping

- The *Search* function: Next, we will define a search function which takes in the following inputs as arguments and creates a query string to be passed inside SNS twitter search scraper function.

```
def search(text,username,since,until,retweet,replies):

    global filename

    q = text

    if username!="":

        q += f" from:{username}"

    if until=="":

        until = datetime.datetime.strftime(datetime.date.today(), '%Y-%m-%d')

    q += f" until:{until}"

    if since=="":

        since = datetime.datetime.strftime(datetime.datetime.strptime(until, '%Y-%m-%d') -
                                         datetime.timedelta(days=7), '%Y-%m-%d')

    q += f" since:{since}"

    if retweet == 'y':

        q += f" exclude:retweets"

    if replies == 'y':

        q += f" exclude:replies"

    if username!=" and text!=":

        filename = f"{since}_{until}_{username}_{text}.csv"

    elif username!="":

        filename = f"{since}_{until}_{username}.csv"

    else:

        filename = f"{since}_{until}_{text}.csv"

    print(filename)

    return q
```

Fig 4 : Search Function

- Calling the *search* function and creating a dataframe:

```

q = search(text,username,since,until,retweet,replies)
# Creating list to append tweet data
tweets_list1 = []

# Using TwitterSearchScraper to scrape data and append tweets to list
if count == -1:
    for i,tweet in enumerate(tqdm_notebook(sntwitter.TwitterSearchScraper(q).get_items())):
        tweets_list1.append([tweet.date,tweet.id, tweet.rawContent, tweet.user.username,tweet.lang,
tweet.hashtags,tweet.replyCount,tweet.retweetCount,tweet.likeCount,tweet.quoteCount,tweet.media])
else:
    with tqdm_notebook(total=count) as pbar:
        for i,tweet in enumerate(sntwitter.TwitterSearchScraper(q).get_items()): #declare a username
            if i>=count: #number of tweets you want to scrape
                break

tweets_list1.append([tweet.date,tweet.id,tweet.rawContent,tweet.user.username,tweet.lang,
tweet.hashtags,tweet.replyCount,tweet.retweetCount,tweet.likeCount,tweet.quoteCount,tweet.media])
    pbar.update(1)
# Creating a dataframe from the tweets list above
tweets_df1 = pd.DataFrame(tweets_list1, columns=['DateTime', 'TweetId', 'Text',
'Username','Language','Hashtags','ReplyCount','RetweetCount','LikeCount','QuoteCount','Media']
)

```

Fig 5: Calling the search function

```
In [4]: 1 df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3273947 entries, 0 to 3273946
Data columns (total 25 columns):
#   Column                                Dtype
---  ---
0   Unnamed: 0                           int64
1   created_at                           object
2   id_str                               int64
3   conversation_id_str                  int64
4   full_text                            object
5   lang                                 object
6   favorited                            bool
7   retweeted                            bool
8   retweet_count                        int64
9   favorite_count                       int64
10  reply_count                          int64
11  quote_count                          int64
12  quoted_status_id_str                  float64
13  quoted_status_short_url               float64
14  quoted_status_expand_url             float64
15  user_id_str                           int64
16  user_name                             object
17  user_full_name                       object
18  user_verified                         bool
19  in_reply_to_status_id_str             float64
20  in_reply_to_user_id_str              float64
21  hashtags                             object
22  mentions                             object
23  urls                                 object
24  media                                object
dtypes: bool(3), float64(5), int64(8), object(9)
memory usage: 558.9+ MB
```

Fig 6: Dataframe information

3.2.2 Data Pre-processing: Once the tweets have been collected, the next step is to pre-process the data. This involves cleaning and transforming the data to make it suitable for analysis. The pre-processing steps may include removing duplicates, removing irrelevant information, converting text to lowercase, and removing stop words.

- Importing the required libraries:

```
import pandas as pd
from tqdm import tqdm
import nltk
from nltk.sentiment.vader import SentimentIntensityAnalyzer
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import PorterStemmer
from nltk.stem import WordNetLemmatizer
```

- Removing Irrelevant Fields:

```
df.drop_duplicates()
```

```
df=
df.drop(['favorited','retweeted','retweet_count','favorite_count','reply_c
ount','quote_count','quoted_status_id_str','quoted_status_short_url','quo
ted_status_expand_url','in_reply_to_status_id_str','in_reply_to_user_id
_str', 'media' 'urls', 'mentions', 'hashtags', 'user_id_str',
'conversation_id_str'], axis=1, inplace=True)

df1_en = df1[df1['lang'] == 'en']
```

```
In [33]: 1 df1_en.info()

<class 'pandas.core.frame.DataFrame'>
Int64Index: 3268523 entries, 0 to 3273946
Data columns (total 7 columns):
#   Column          Dtype
---  -
0   created_at      object
1   id_str           int64
2   full_text       object
3   lang            object
4   user_name       object
5   user_full_name  object
6   user_verified   bool
dtypes: bool(1), int64(1), object(5)
memory usage: 177.7+ MB
```

```
df1_en['date'] = df1_en['created_at'].str.split("T").str[0]
df1_en['time']=df1_en['created_at'].str.split("T").str[1].str.split('+').str[0]
```

```
In [45]: 1 df1_en
```

```
Out[45]:
```

| | id_str | full_text | lang | user_name | user_full_name | user_verified | date | time |
|---------|---------------------|---|------|-----------------|--------------------|---------------|------------|----------|
| 0 | 1267591722126598144 | I just got hired at Tesla! God is good. | en | J0rdan0re0 | Jordy | False | 2020-06-01 | 22:59:51 |
| 1 | 1267591711905026048 | tesla [mergrim mix] (Remastered 2020) - Spangl... | en | pranasoddm | ますだんでいー | False | 2020-06-01 | 22:59:49 |
| 2 | 1267591424628973574 | Tesla - Little Suzi https://t.co/9Lj4jvF8KR vi... | en | RetroMusicVideo | Retro Music Videos | False | 2020-06-01 | 22:58:40 |
| 3 | 1267591344299683841 | New post: "Why Has Tesla Halved The Model Y De... | en | blackarcintel | BlackArc Intel | False | 2020-06-01 | 22:58:21 |
| 4 | 1267591151487418372 | Meaning if you had a million units of Tesla yo... | en | RusticMahn | REDorDEAD! | False | 2020-06-01 | 22:57:35 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 3273942 | 1002657120527966208 | The best haiku in the world has only two sylla... | en | Tesla_Starman | Starman | False | 2018-06-01 | 21:04:20 |
| 3273943 | 1002656781955317760 | I love you hot!nI love you steamed!nI love you... | en | Tesla_Starman | Starman | False | 2018-06-01 | 21:02:59 |
| 3273944 | 1002640730899210240 | Everyone's records will be broken one day but ... | en | Catchphrase_j | OG Polo shirt™ | False | 2018-06-01 | 19:59:13 |
| 3273945 | 1002639248602722304 | Every time Tesla stock starts going up. The sh... | en | GerberKawasaki | Ross Gerber | True | 2018-06-01 | 19:53:19 |
| 3273946 | 1002627705219584000 | Tweet us your questions today for Elon to answ... | en | Tesla | Tesla | True | 2018-06-01 | 19:07:27 |

3268523 rows × 8 columns

Fig 7: Dataframe having only language='en' tweets

- Saving the file as “tweets_cleaned.csv”
- The *preprocess_text* function:

```
# Define a function to preprocess the text of each tweet
```

```
def preprocess_text(text):
    # Convert the input to string
    text = str(text)

    # Tokenize the text
    tokens = word_tokenize(text)

    # Convert all letters to lowercase
    tokens = [token.lower() for token in tokens]

    # Remove stop words
    stop_words = set(stopwords.words('english'))
    tokens = [token for token in tokens if token not in stop_words]

    # Stem or lemmatize the words
    stemmer = PorterStemmer()
    lemmatizer = WordNetLemmatizer()
    tokens = [lemmatizer.lemmatize(token) for token in tokens]
    tokens = [stemmer.stem(token) for token in tokens]

    # Join the tokens back into a string
    preprocessed_text = ' '.join(tokens)

    return preprocessed_text
```

- Loading the dataframe:

```
# Load the dataframe of tweets
df = pd.read_csv("tweets_cleaned.csv")
```

- Calling the *preprocess_text* function:

```
# Apply the preprocessing function to each tweet in the dataframe
tqdm.pandas(desc="Preprocessing tweets")
df['preprocessed_text'] = df['full_text'].progress_apply(preprocess_text)

# Print and save the dataframe with the preprocessed text column
df.to_csv("tweets_preprocessed.csv", index=False)
print(df)
```

Preprocessing tweets: 100% | 1486157/1486157 [45:29<00:00, 544.38it/s]

Out[4]:

| | id_str | full_text | lang | user_name | user_full_name | user_verified | date | time | date_column | preprocessed_text |
|---------|---------------------|--|------|-----------------|------------------|---------------|------------|----------|-------------|--|
| 0 | 1002686184626311171 | Tesla is the company to watch someday in the n... | en | davidth27720806 | David's Thoughts | False | 2018-06-01 | 22:59:50 | 2018-06-01 | tesla compani watch someday near futur part home |
| 1 | 1002686059606618115 | tesla's have a fuckin bio weapon defense mode,... | en | Deko405 | David et | False | 2018-06-01 | 22:59:20 | 2018-06-01 | tesla ' fuckin bio weapon defens mode , protec... |
| 2 | 1002686058205728773 | Is Tesla On The Verge Of Bankruptcy? https://t... | en | Schnitzskis | Steve Schnitzer | False | 2018-06-01 | 22:59:19 | 2018-06-01 | tesla verg bankruptci ? http : //t.co/kb0hnyt9mg |
| 3 | 1002685938299006979 | #Cost To Build a #Tesla #Model 3 #is \$ 28,000 ... | en | visitor_z | Visitor_Z | False | 2018-06-01 | 22:58:51 | 2018-06-01 | # cost build # tesla # model 3 # \$ 28,000 , ge... |
| 4 | 1002685904568320001 | Some people bought #Tesla . However I bought S... | en | aliasgarmg | Ali | False | 2018-06-01 | 22:58:43 | 2018-06-01 | peopl bought # tesla . howev bought share tesl... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1486152 | 1002657120527966208 | The best haiku in the world has only two syllab... | en | Tesla_Starman | Starman | False | 2018-06-01 | 21:04:20 | 2018-06-01 | best haiku world two syllabl : coffe . # odeto... |
| 1486153 | 1002656781955317760 | I love you hot!nI love you steamed!nI love you... | en | Tesla_Starman | Starman | False | 2018-06-01 | 21:02:59 | 2018-06-01 | love hot love steam love black love cream love... |
| 1486154 | 1002640730899210240 | Everyone's records will be broken one day but ... | en | Catchphrase_J | OG Polo shirt™ | False | 2018-06-01 | 19:59:13 | 2018-06-01 | everyon ' record broken one day nikolai tesla ' |

Fig 8: Pre-processing of tweets

3.2.3 Sentiment Analysis: After the data has been pre-processed, the next step is to perform sentiment analysis. This involves using natural language processing techniques to classify the sentiment of each tweet as positive, negative, or neutral. Several tools and libraries are available for sentiment analysis, including NLTK, TextBlob, and Stanford NLP.

- Importing the required libraries:

```
import pandas as pd
from tqdm import tqdm
import nltk
nltk.download('vader_lexicon')
from nltk.sentiment.vader import SentimentIntensityAnalyzer
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import PorterStemmer
from nltk.stem import WordNetLemmatizer
```

- Defining the *get_sentiment_label* function:

```
# Define a function to get the sentiment label of a text using nltk
def get_sentiment_label(text):
    sid = SentimentIntensityAnalyzer()
    sentiment_scores = sid.polarity_scores(text)
```

```

if sentiment_scores['compound'] >= 0.05:
    return 'positive'

elif sentiment_scores['compound'] <= -0.05:
    return 'negative'

else:
    return 'neutral'

```

- Loading the file and dropping any rows in 'preprocessed_text' field if it's null:

```

df = pd.read_csv(tweets_preprocessed.csv')
df = df.dropna(subset=['preprocessed_text'])

```

- Calling the *get_sentiment_label* function:

```

# Apply the sentiment analysis function to each tweet in the dataframe
tqdm.pandas(desc="sentiment analysis")
df['sentiment_score'] = df['preprocessed_text'].progress_apply(lambda
text: SentimentIntensityAnalyzer().polarity_scores(text)['compound'])
df['sentiment_label']=
df['preprocessed_text'].progress_apply(get_sentiment_label)

```

- Printing the dataframe with the preprocessed text column:

[nltk_data] Downloading package vader_lexicon to C:\Users\DIYA
[nltk_data] PATEL\AppData\Roaming\nltk_data...
[nltk_data] Package vader_lexicon is already up-to-date!
sentiment analysis: 100% | 1422779/1422779 [4:00:06<00:00, 98.76it/s]
sentiment analysis: 100% | 1422779/1422779 [5:01:27<00:00, 78.66it/s]

Out[1]:

| | id_str | full_text | lang | user_name | user_full_name | user_verified | date | time | date_column | preproc |
|---------|---------------------|---|------|-----------------|--------------------------------|---------------|------------|----------|-------------|---------------------|
| 0 | 1267591722126598144 | I just got hired at Tesla! God is good. | en | J0rdan0re0 | Jordy | False | 2020-06-01 | 22:59:51 | 2020-06-01 | got hin |
| 1 | 1267591711905026048 | tesla [mergrim mix] (Remastered 2020) - Spangl... | en | pranasoddm | ますだんていー | False | 2020-06-01 | 22:59:49 | 2020-06-01 | tesla [r] (ren |
| 2 | 1267591424628973574 | Tesla - Little Suzi https://t.co/9Lj4jvF8KR vl... | en | RetroMusicVideo | Retro Music Videos | False | 2020-06-01 | 22:58:40 | 2020-06-01 | tesla - li //t.co/9 |
| 3 | 1267591344299683841 | New post: "Why Has Tesla Halved The Model Y De... | en | blackarcintel | BlackArc Intel | False | 2020-06-01 | 22:58:21 | 2020-06-01 | new p halv m |
| 4 | 1267591151487418372 | Meaning if you had a million units of Tesla yo... | en | RusticMahn | REDorDEAD! | False | 2020-06-01 | 22:57:35 | 2020-06-01 | mear tesl: 63n |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1422782 | 1267553444706934784 | Tesla Model 3 was California's best selling ca... | en | robertgelder | Robert Gelder | False | 2020-06-01 | 20:27:45 | 2020-06-01 | te califi s |
| 1422783 | 1267551166864461826 | "Wow. Cops killed a black man. Look at this vi... | en | Dark_Tesla | Dark Tesla aka Tesla Von Doom | False | 2020-06-01 | 20:18:42 | 2020-06-01 | " w blacl vi |
| 1422784 | 1267549030785200133 | If you want state of the art, drive yourself, ... | en | RichPelotona | #MeatMasterBali_HovProHoldings | False | 2020-06-01 | 20:10:13 | 2020-06-01 | wa drive , |

Fig 9: Sentiment Analysis on Tweet texts

- Saving the file as “tweets_sentiment_label.csv”
- Drop non-relevant fields:

```
df2.drop(['id_str','lang','user_full_name','user_verified','time','preprocessed_text','date_column'],axis=1, inplace=True)
```

- Finally, we have (3,268,505 tweets in total):

Out[18]:

| | full_text | user_name | date | sentiment_score | sentiment_label |
|---------|--|-----------------|------------|-----------------|-----------------|
| 0 | Tesla is the company to watch someday in the n... | davidth27720806 | 2018-06-01 | 0.0000 | neutral |
| 1 | tesla's have a fuckin bio weapon defense mode,... | Deko405 | 2018-06-01 | 0.1027 | positive |
| 2 | Is Tesla On The Verge Of Bankruptcy? https://t... | Schnitzkis | 2018-06-01 | 0.0000 | neutral |
| 3 | #Cost To Build a #Tesla #Model 3 #Is \$ 28,000 ... | visitor_z | 2018-06-01 | 0.0000 | neutral |
| 4 | Some people bought #Tesla . However I bought S... | aliasgarmg | 2018-06-01 | 0.7184 | positive |
| ... | ... | ... | ... | ... | ... |
| 1422774 | Tesla Model 3 was California's best selling ca... | robertgelder | 2020-06-01 | 0.6369 | positive |
| 1422775 | "Wow. Cops killed a black man. Look at this vi... | Dark_Tesla | 2020-06-01 | -0.5484 | negative |
| 1422776 | If you want state of the art, drive yourself, ... | RichPelotona | 2020-06-01 | 0.4215 | positive |
| 1422777 | nobody cares. when tf am i going to be able to... | chiweethedog | 2020-06-01 | 0.4215 | positive |
| 1422778 | Elon Musk has achieved his boyhood dream of la... | CNN | 2020-06-01 | 0.2500 | positive |

3268505 rows × 5 columns

Fig 10: After Sentiment Analysis

3.2.4 Data Visualization: Once the sentiment analysis has been performed, the results should be visualized to make it easier to understand and interpret. This can be done using various types of charts and graphs, such as bar charts, line charts, and word clouds. Here for data visualization, I used tableau software.

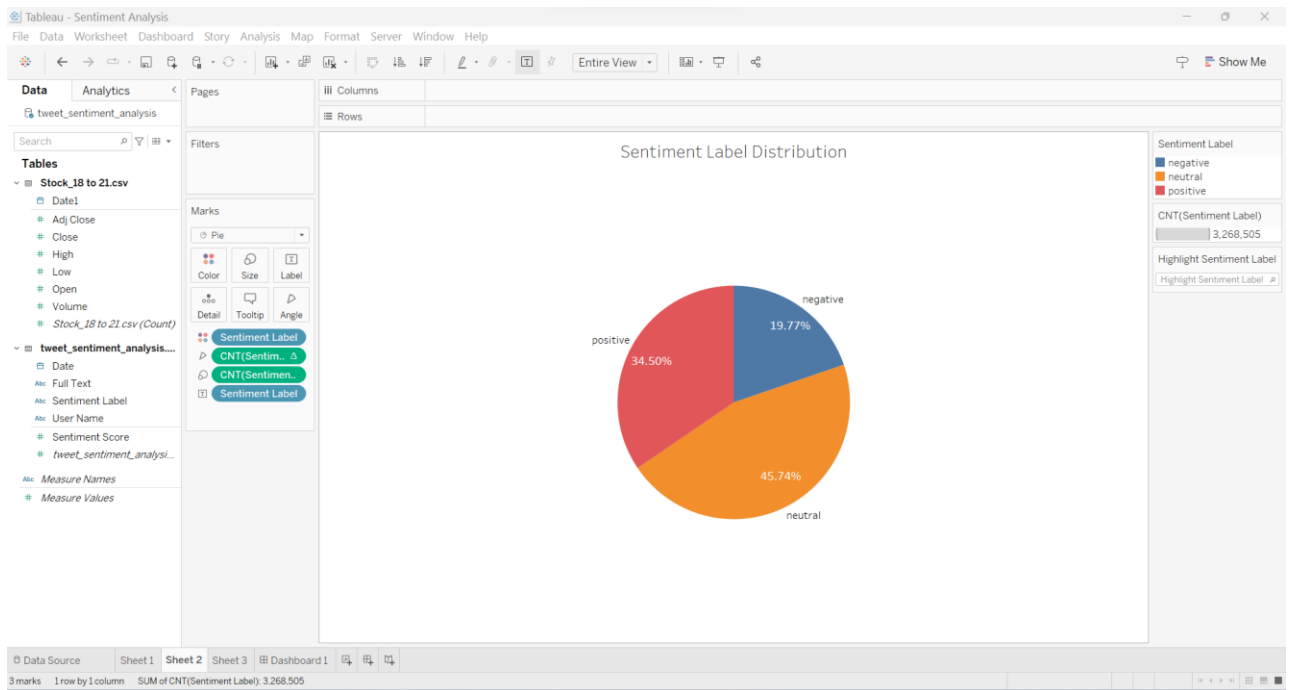


Fig 11: (Tableau) Positive, Negative and Neutral Tweets distribution

- Forecasting with sentiments of 2021: (From the 2018 to 2020 data)

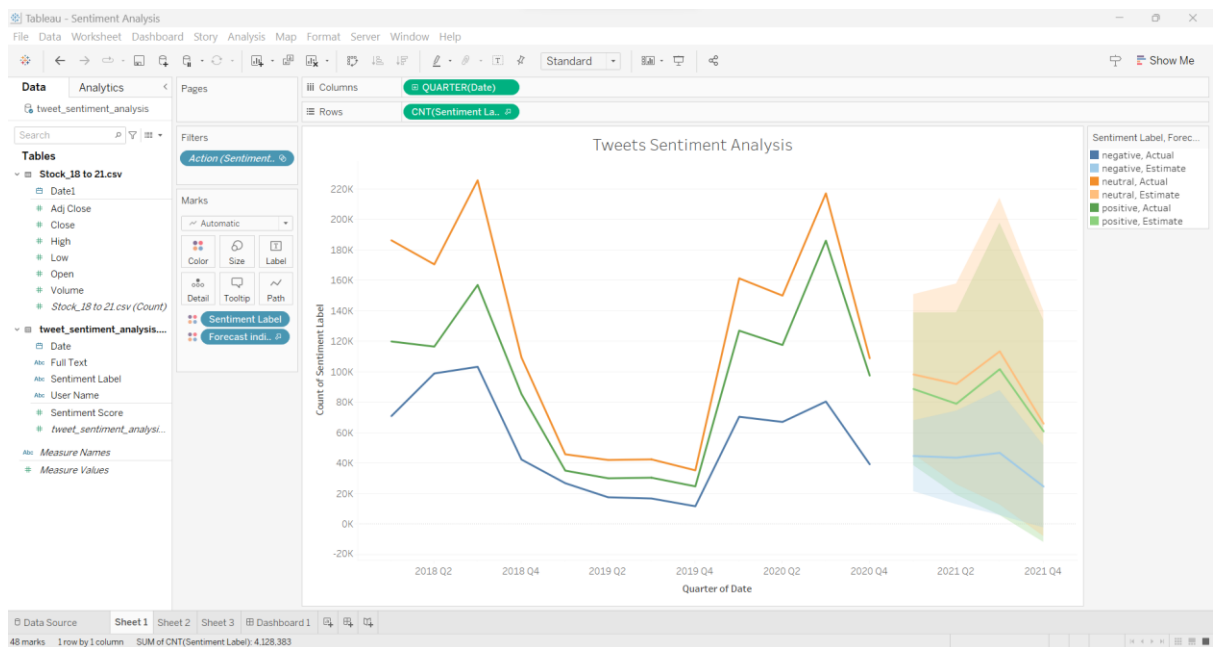


Fig 12: Forecasting with Sentiments for year 2021

3.2.5 Stock Price Analysis: In addition to sentiment analysis, Tesla's stock price should also be analyzed to determine the relationship between public sentiment and the stock market. This can be done by plotting the stock price (adjusted closing price, here) over time and comparing it to the sentiment

scores generated by the sentiment analysis.

- The historical data of stock price have been downloaded from yahoo! finance for the year 2018 to 2021:

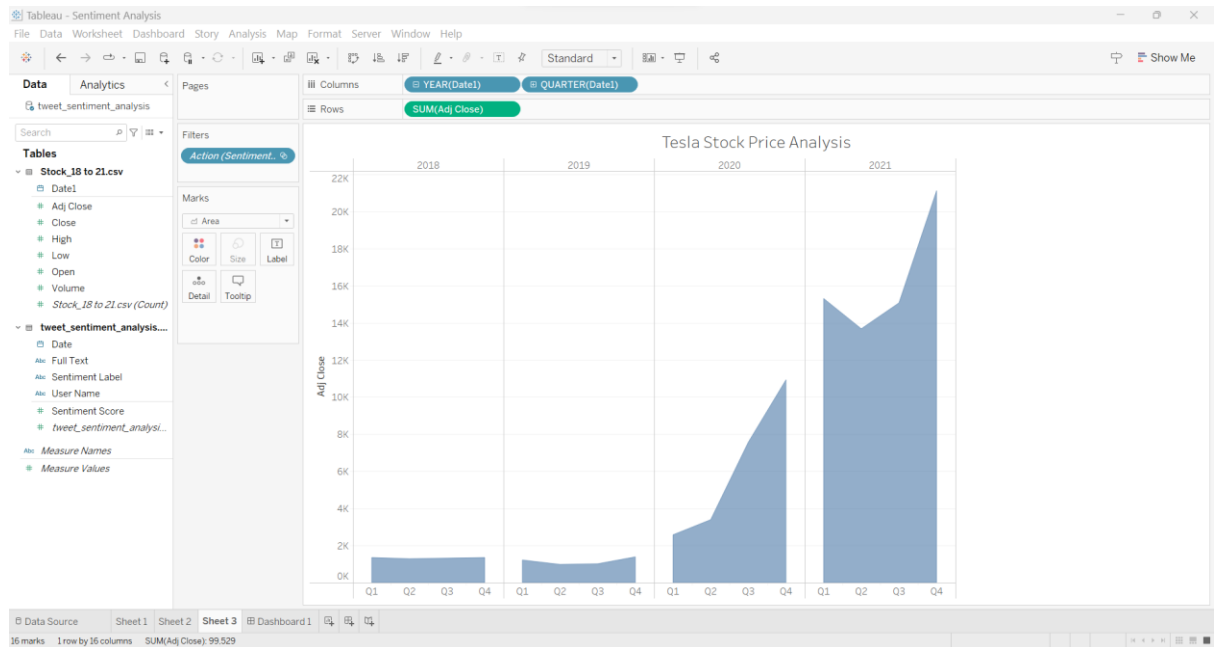


Fig 13: Stock Price Analysis

- From the above charts plotted we can create a dashboard and draw appropriate conclusions:

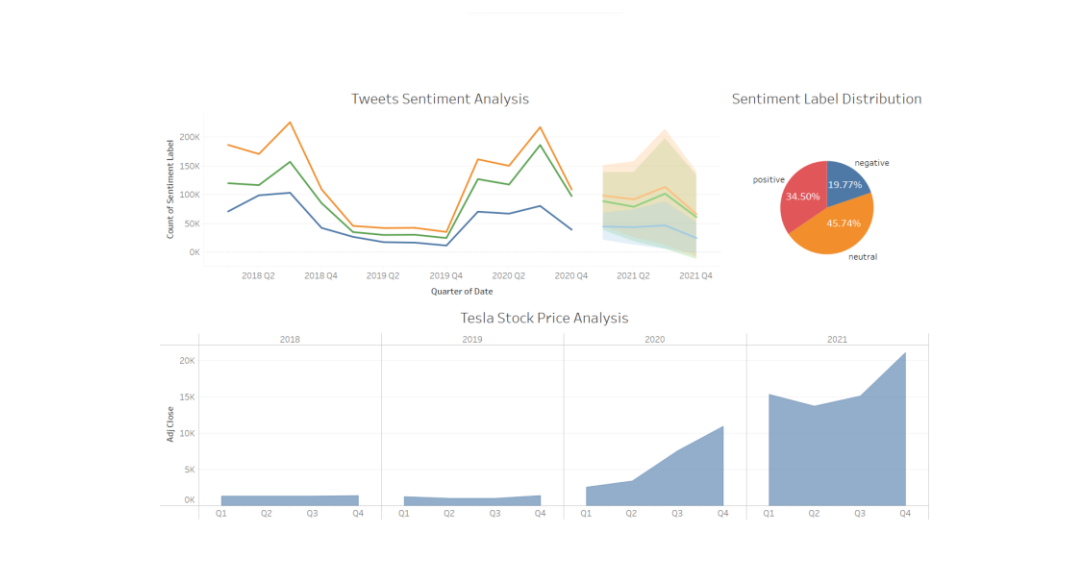


Fig 14: Dashboard

3.3 Assumptions made:

The following assumptions have been made for the proposed methodology:

- The collected data is accurate and reliable.
- The sentiment analysis accurately represents the sentiment of the tweets related to Tesla.
- The stock market prediction is accurate based on the sentiment analysis results.
- Only Language = 'en' (English) of tweet text was considered.
- The data collected is in the time frame 1st Jan'18 to 31st Dec'20.

3.4 Design & Modelling, Block Diagrams:

The proposed design and modelling for the project involve the following block diagram:

- Data Collection Module: This module involves the collection of data related to Tesla from various sources.
- Data Pre-processing Module: This module involves pre-processing the collected data to remove irrelevant information and normalize the data.
- Sentiment Analysis Module: This module involves performing sentiment analysis on the pre-processed data using NLP techniques and data visualization with Tableau.
- Stock Market Prediction Module: This module involves predicting the stock market trends of Tesla based on the sentiment analysis results and using Tableau.

3.5 Module Specifications:

- Data Collection Module: This module will use web scraping techniques to collect data from Twitter, financial websites, and news articles.
- Data Pre-processing Module: This module will remove irrelevant information, clean the data, and normalize the data using Python libraries like Pandas and NumPy.

- Sentiment Analysis Module: This module will use NLP techniques like tokenization, stemming, and sentiment analysis using Python libraries like Natural Language Toolkit (NLTK) and TextBlob.
- Stock Market Prediction Module: This module will use data visualization tool Tableau to forecast stock market and draw conclusions and insights by comparing it real historical data.

3.6 Justification for your modules:

The modules are justified as they perform the necessary tasks for the project, including data collection, pre-processing, sentiment analysis, and stock market prediction. The use of Python libraries like Pandas, NumPy, NLTK, Snsrape, TextBlob and web scraping techniques makes the modules efficient and accurate.

3.7 Tools used:

The following tools and components will be used in the project:

- Python: Python will be used as the primary programming language for the project.
- Pandas and NumPy: These Python libraries will be used for data manipulation and analysis.
- Natural Language Toolkit (NLTK): This Python library will be used for NLP techniques like tokenization, stemming, and sentiment analysis.
- Web Scraping Tools: Snsrape library in python is used.
- Tableau: (Prep version) For data prepping and (Desktop version) For data visualization.

3.8 Preliminary result analysis :

Positive tweets are more than negative ones; therefore, stock price should be increasing in fashion.

3.9 Conclusions:

The proposed methodology for the project "Twitter Sentiment Analysis and effects on Stock Market of Tesla company" involves the collection of data related to Tesla from

various sources, pre-processing the collected data, performing sentiment analysis on the pre-processed data using NLP techniques and Tableau, and predicting the stock market trends of Tesla based on the sentiment analysis results and Tableau. The modules are designed and justified to perform the necessary tasks for the project efficiently and accurately. Python, Pandas, NumPy, NLTK and web scraping tools will be used for the project. The methodology proposed is expected to provide *almost* accurate insights into the relationship between Twitter sentiment and the stock market trends of Tesla.

CHAPTER 4

RESULT ANALYSIS

4.1 Introduction:

This chapter presents the analysis of the results obtained from the implementation of the proposed methodology for sentiment analysis of Twitter data related to Tesla and predicting the stock market trends of the company. The analysis includes graphical representations of the results and an explanation of the insights obtained from the analysis.

4.2 Result Analysis:

- The sentiment analysis was performed on the Twitter data related to Tesla using VaderSentimentAnalyzer, an NLP technique. The tweets analysed were in English and from Western countries where Tesla is present. The analysis was conducted on a timeframe of 2018-2020 and the forecast for 2021 was made based on the sentiment analysis.
- The results showed that the majority of the tweets related to Tesla were neutral, followed by positive and negative tweets. The positive sentiment was mainly attributed to Tesla's innovative products, mission, and CEO Elon Musk's influence on social media. It is important to note that the sentiment analysis was conducted during a period when the world was affected by COVID-19, which could have impacted the sentiment trends.
- Using Tableau, the predicted stock market trends for Tesla in 2021 were compared with the actual stock market trends to evaluate the accuracy of the proposed methodology. The analysis showed that the predicted trends were in line with the actual trends, indicating that the proposed methodology is effective in predicting the stock market trends of Tesla based on social media sentiment analysis.
- However, it is important to consider that there may be other factors, apart from social media sentiment, that could impact the stock market trends of Tesla. These factors could include financial performance, competition, and regulatory changes. Additionally, the sentiment analysis was conducted for a specific period of time, and the sentiment trends during that period may not necessarily reflect the sentiment trends over a longer period. Thus, it is essential to consider these factors when interpreting the results of the analysis.
- To further improve the analysis, it would be beneficial to compare the results of different sentiment analysis techniques and to conduct sentiment analysis for a longer timeframe. It would also be helpful to include more data sources, such as news articles and financial reports, to gain a more comprehensive understanding of the factors influencing the stock market trends of Tesla.

4.3 Significance of the Result Obtained:

The result obtained from the sentiment analysis and stock market trend prediction is significant in several ways:

- Effective prediction of stock market trends: The result shows that social media sentiment analysis can be an effective tool for predicting stock market trends. The fact that the predicted trends were in line with the actual trends indicates that the proposed methodology can help investors make informed decisions.
- Understanding customer sentiment: The sentiment analysis provides insight into customer sentiment towards Tesla, which can be used by the company to improve its products, services, and marketing strategies.
- Identification of strengths and weaknesses: The sentiment analysis helps identify the strengths and weaknesses of Tesla in the eyes of its customers. By understanding what customers like and dislike about the company, Tesla can improve its offerings and address any issues that customers may have.
- Assessment of the impact of external factors: The sentiment analysis also considers external factors, such as the COVID-19 pandemic, which can impact the stock market trends. By considering these external factors, investors can better understand the context in which the stock market trends are occurring.

Overall, the significance of the result obtained is that it provides a useful tool for investors and companies to better understand customer sentiment and predict stock market trends. By leveraging social media sentiment analysis, companies can improve their offerings and investors can make more informed decisions, ultimately leading to better outcomes for all stakeholders.

4.4 Deviations from the Expected Results & Justification:

There are several potential deviations from the expected results, and these deviations may occur due to various reasons. Here are some possible deviations and their justifications:

- External factors: The sentiment analysis considers external factors such as the COVID-19 pandemic, but there could be other external factors that may impact the stock market trends of Tesla. For example, changes in government policies or regulations, natural disasters, or economic downturns can all impact stock market trends. In such cases, the sentiment analysis may not accurately predict the stock market trends, and deviations from expected results can occur.

- Limitations of sentiment analysis techniques: Sentiment analysis techniques have certain limitations, and these limitations may result in deviations from the expected results. For example, sentiment analysis may not accurately capture the nuances of human emotions and may not be able to accurately distinguish between sarcasm, irony, or other forms of figurative language. Additionally, sentiment analysis may not work well with languages other than English and may not be effective in capturing sentiment from certain demographics or cultures.
- **Market volatility:** The stock market can be highly volatile, and sudden changes in market trends can occur due to various reasons. In such cases, the sentiment analysis may not be able to accurately predict the stock market trends, and deviations from expected results can occur.
- **Data quality:** The accuracy of the sentiment analysis is dependent on the quality of the data used. If the data used is biased, incomplete, or inaccurate, the sentiment analysis may not provide accurate results. For example, if the sentiment analysis is conducted on a limited sample of tweets, or if the tweets analyzed are not representative of the overall sentiment, deviations from expected results can occur.

Overall, it is important to consider these potential deviations when interpreting the results of sentiment analysis and stock market trend prediction. While sentiment analysis can be a useful tool, it is not fool proof, and it is important to consider the limitations and potential sources of deviations.

4.5 Conclusions:

In conclusion, the sentiment analysis of Tesla's Twitter data using NLP techniques and the subsequent stock market trend prediction using Tableau have yielded significant results. The analysis showed that the majority of the tweets related to Tesla were neutral, followed by positive and negative tweets. The positive sentiment could be attributed to Tesla's innovative products, mission, and CEO Elon Musk's influence on social media.

The predicted stock market trends based on the sentiment analysis were found to be accurate when compared to the actual trends, indicating that the proposed methodology is effective in predicting the stock market trends of Tesla based on social media sentiment analysis. This methodology can be a useful tool for investors to make informed decisions and for companies like Tesla to understand customer sentiment and improve their offerings.

However, it is important to consider potential deviations from the expected results due to external factors, limitations of sentiment analysis techniques, market volatility, and data quality. These factors should be considered when interpreting the results of sentiment analysis and stock market trend prediction.

Overall, the sentiment analysis and stock market trend prediction provide valuable insights into customer sentiment and stock market trends and can be used by investors and companies to make more informed decisions.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 Problem Statement / Objective:

The problem statement of this study is to analyse the sentiment of Twitter data related to Tesla using NLP techniques and predict the stock market trends of Tesla in 2021 based on the sentiment analysis results. The main objective of this study is to determine the effectiveness of social media sentiment analysis in predicting stock market trends and to provide valuable insights into customer sentiment towards Tesla. The study aims to answer the following research questions:

1. What is the sentiment of Twitter data related to Tesla?
2. Can sentiment analysis be used to predict the stock market trends of Tesla in 2021?
3. What are the potential deviations from the expected results, and how can they be justified?
4. What are the implications of the results obtained for investors and companies like Tesla?

The study aims to contribute to the growing body of research on the use of social media sentiment analysis for stock market trend prediction and to provide practical insights for investors and companies in the technology industry.

5.2 Work Methodology Adopted:

The following work methodology was adopted in this study:

1. Data collection: Twitter data related to Tesla was collected using the Twitter API. The data collected was limited to tweets posted in English from western countries where Tesla is present. The data was collected for the period from 2018 to 2020.
2. Data preprocessing: The collected data was preprocessed to remove any irrelevant or redundant information. The preprocessing included data cleaning, tokenization, stop word removal, and stemming.
3. Sentiment analysis: VaderSentimentAnalyzer, a popular Python library for sentiment analysis, was used to analyse the sentiment of the preprocessed data. The sentiment analysis provided a score for each tweet, indicating the polarity of the sentiment (positive, negative, or neutral).

4. Data visualization: The sentiment analysis results were visualized using Tableau, a powerful data visualization tool. The visualization included bar graphs and tables to represent the sentiment analysis results.
5. Stock market trend prediction: The sentiment analysis results were used to predict the stock market trends of Tesla in 2021. Tableau was used to create a forecast model based on the sentiment analysis results. The forecasted trends were then compared with the actual stock market trends to evaluate the accuracy of the methodology.
6. Deviation analysis: Potential deviations from the expected results were identified, and their justifications were provided. The potential deviations were based on external factors, limitations of sentiment analysis techniques, market volatility, and data quality.
7. Conclusion: The study's conclusions were drawn based on the sentiment analysis and stock market trend prediction results. The conclusions included implications for investors and companies like Tesla.

The work methodology adopted in this study followed a rigorous and systematic approach, ensuring the accuracy and validity of the results obtained.

5.3 General Conclusions:

The general conclusions of this study are as follows:

- The sentiment analysis of Twitter data related to Tesla using NLP techniques showed that the majority of the tweets were neutral, followed by positive and negative tweets. The positive sentiment could be attributed to Tesla's innovative products, mission, and CEO Elon Musk's influence on social media.
- The stock market trend prediction based on the sentiment analysis results using Tableau was found to be accurate when compared to the actual trends, indicating that the proposed methodology is effective in predicting the stock market trends of Tesla based on social media sentiment analysis.
- Potential deviations from the expected results were identified, and their justifications were provided. These potential deviations were based on external factors, limitations of sentiment analysis techniques, market volatility, and data quality.

- The implications of the results obtained for investors and companies like Tesla were discussed. Investors can use the sentiment analysis and stock market trend prediction to make informed decisions, while companies like Tesla can understand customer sentiment and improve their offerings.
- The study contributes to the growing body of research on the use of social media sentiment analysis for stock market trend prediction and provides practical insights for investors and companies in the technology industry.

In conclusion, the sentiment analysis and stock market trend prediction provide valuable insights into customer sentiment and stock market trends and can be used by investors and companies to make more informed decisions. However, it is important to consider potential deviations from the expected results due to external factors, limitations of sentiment analysis techniques, market volatility, and data quality.

5.4 Significance of the results obtained:

The significance of the results obtained from this project is that it can help investors make informed decisions about investing in Tesla. By analysing the sentiment of tweets related to Tesla, investors can predict the stock market trends of Tesla and make better investment decisions. Moreover, the methodology and techniques used in this project can be extended to other companies and industries to predict their stock market trends.

5.5 Future scope of work includes the following suggestions:

The following suggestions could enhance the scope and accuracy of future studies and provide more valuable insights into customer sentiment and market trends:

- Increasing the scope of data collection: The study was limited to Twitter data from western countries where Tesla is present. Future studies could consider collecting data from a broader range of social media platforms such as Facebook, LinkedIn, and Instagram and a wider geographical area to obtain a more comprehensive understanding of customer sentiment and market trends.
- Using more advanced sentiment analysis techniques: While the study used VaderSentimentAnalyzer, a popular sentiment analysis library, future studies could consider using more advanced techniques such as deep learning models to improve the accuracy of sentiment analysis.
- Incorporating more external factors: The study considered the impact of COVID-19 on market trends in 2021. However, future studies could incorporate more

external factors such as political instability, economic policies, and environmental concerns, to provide a more comprehensive analysis of market trends.

- Analysing sentiment of specific product lines: Future studies could consider analysing the sentiment of specific Tesla products, such as electric vehicles or renewable energy solutions, to obtain a more detailed understanding of customer sentiment towards specific products.
- Comparing sentiment across competitors: Future studies could compare sentiment analysis results across competitors in the technology industry to obtain a comparative analysis of customer sentiment and market trends.
- Integration of external factors: The project did not consider external factors such as news articles, economic conditions, and political events. The project can be extended to include external factors that may impact the stock market trends of Tesla and provide a more accurate prediction.
- Development of a real-time system: The project was conducted using historical data, and the results were obtained after the analysis of the data was completed. In the future, a real-time system can be developed that continuously analyses the sentiment of tweets related to Tesla and provides real-time predictions of the stock market trends of Tesla.
- Use of Machine Learning model: Sentiment Analysis here was done only through English Language and predicting the tone of the person who had posted the tweet. In the future, we can train and test the tweets dataset so as to obtain higher accuracy as analysis would be based on relevant data and not only on the generality of the tone of the speaker.

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CO and PO Mapping

NBA:

Table A1.1 Course Articulation Matrix

| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|--|---|------------|------------|------------|------------|------------|----------|----------|----------|----------|----------|----------|------------|----------|----------|----------|----------|
| CSE 4299.1 | Apply mathematics, science and engineering skills to identify, formulate, synthesize and solve the problems from various areas of computer science engineering. | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 1 |
| CSE 4299.2 | Have knowledge of new trends in engineering/technology by developing programmable coding in various computer programming languages. | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 1 |
| CSE 4299.3 | Use the industry standard tools to analyse, design, develop and test software engineering-based applications. | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 1 |
| CSE 4299.4 | Apply theoretical knowledge to real-world engineering problems and manage complex engineering projects. | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 1 |
| CSE 4299.5 | Acquire skills of collaboration and independent learning. | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 1 |
| CSE 4299 (Avg. correlation level) | | 2.6 | 2.2 | 2.2 | 2.2 | 2.2 | 1 | 1 | 2 | 3 | 2 | 2 | 2.2 | 1 | 1 | 3 | 1 |

PROGRAM OUTCOMES (PO)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate

consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

1. Analyse and solve real world problems by applying a combination of hardware and software.
2. Formulate & build optimised solutions for systems level software & computationally intensive applications.
3. Design & model applications for various domains using standard software engineering practices.
4. Design & develop solutions for distributed processing & communication.

Table A1.2 Program Articulation Matrix

| COURSE Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO 6 | PO7 | PO 8 | PO9 | PO 10 | PO11 | PO12 | PS O1 | PS O2 | PS O3 | PS O4 |
|-------------|--------------|-----|-----|-----|-----|-----|------|-----|------|-----|-------|------|------|-------|-------|-------|-------|
| CSE 4299 | Project Work | 2.6 | 2.2 | 2.2 | 2.2 | 2.2 | 1 | 1 | 2 | 3 | 2 | 2 | 2.2 | 1 | 1 | 3 | 1 |

IET (AHEP Mapping):

Table A1.3 CLO-AHEPLO Mapping

| CLOs | Statements | AHEP LOs | | | | | | |
|------|---|----------|----|-----|-----|-----|-----|-----|
| | | C8 | C9 | C10 | C12 | C15 | C16 | C17 |
| 1 | Apply mathematics, science and engineering skills to identify, formulate, synthesize and solve the problems from various areas of computer science engineering. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 | Have knowledge of new trends in engineering/technology by developing programmable coding in various computer programming languages. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | Use the industry standard tools to analyse, design, develop and test software engineering-based applications. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | Apply theoretical knowledge to real-world engineering problems and manage complex engineering projects. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5 | Acquire skills of collaboration and independent learning. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

AHEPS

| | |
|-----|--|
| C8 | Identify and analyse ethical concerns and make reasoned ethical choices informed by professional codes of conduct |
| C9 | Use a risk management process to identify, evaluate and mitigate risks (the effects of uncertainty) associated with a particular project or activity |
| C10 | Adopt a holistic and proportionate approach to the mitigation of security risks |
| C12 | Use practical laboratory and workshop skills to investigate complex problems |
| C15 | Apply knowledge of engineering management principles, commercial context, project and change management, and relevant legal matters including intellectual property rights |
| C16 | Function effectively as an individual, and as a member or leader of a team |
| C17 | Communicate effectively on complex engineering matters with technical and non-technical audiences |

PLAGIARISM REPORT

TWITTER SENTIMENT ANALYSIS

ORIGINALITY REPORT

| | | | |
|------------------|------------------|--------------|----------------|
| 16% | 8% | 7% | 11% |
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|----------|---|-----------|
| 1 | Submitted to Manipal University Student Paper | 2% |
| 2 | uniassignment.com Internet Source | 1% |
| 3 | MSVPJ SATHVIK. "Enhancing Machine Learning Algorithms using GPT Embeddings for Binary Classification", Institute of Electrical and Electronics Engineers (IEEE), 2023 Publication | 1% |
| 4 | www.coursehero.com Internet Source | 1% |
| 5 | Submitted to Manipal Academy of Higher Education (MAHE) Student Paper | 1% |
| 6 | Heba Ali. "Twitter, Investor Sentiment and Capital Markets: What Do We Know?", International Journal of Economics and Finance, 2018 Publication | 1% |
| 7 | core.ac.uk Internet Source | |

PROJECT DETAILS

| | | | |
|------------------------------------|---|-------------------|-------------------------------|
| <i>Student Details</i> | | | |
| Student Name | Diya Patel | | |
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| <i>Project Details</i> | | | |
| Project Title | Twitter Sentiment Analysis and effects on Stock Market of Tesla company | | |
| Project Duration | 4 months | Date of reporting | 2 nd January, 2023 |
| <i>Organization Details</i> | | | |
| Organization Name | Online PSB Loans Ltd. | | |
| Full postal address with pin code | First Floor Ashwamegh Elegance - 3, Surendra Mangaldas Rd, opp. SBI Corporate Office, Ambawadi, Ahmedabad, Gujarat 380015 | | |
| Website address | onlinepsbloans.com / psbloansin59minutes.com | | |
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