

An Industrial Oriented Mini Project Report on

TWITTER ANALYSIS MOBILE APPLICATION

Submitted in Partial fulfillment of requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE AND ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

KESHAV MEMORIAL INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Accredited by NBA & NAAC, Approved by AICTE, Affiliated to JNTUH.

**Narayanaguda, Hyderabad,
Telangana-29**

2023-24



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that this is a bonafide record of the project report titled **“TWITTER ANALYSIS MOBILE APPLICATION”** which is being presented as the Industrial Oriented Mini Project report by

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PO3. 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.

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PO5. Modern Tool Usage: Create select, and, apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by contextual knowledge to societal, health, safety. Legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

PO10. 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.

PO11. 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.

PO12. 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 (PSOs)

PSO1: An ability to analyze the common business functions to design and develop appropriate Information Technology solutions for social upliftments.

PSO2: Shall have expertise on the evolving technologies like Python, Machine Learning, Deep learning, IOT, Data Science, Full stack development, Social Networks, Cyber Security, Mobile Apps, CRM, ERP, Big Data, etc.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will have successful careers in computer related engineering fields or will be able to successfully pursue advanced higher education degrees.

PEO2: Graduates will try and provide solutions to challenging problems in their profession by applying computer engineering principles.

PEO3: Graduates will engage in life-long learning and professional development by rapidly adapting to the changing work environment.

PEO4: Graduates will communicate effectively, work collaboratively and exhibit high levels of professionalism and ethical responsibility.

PROJECT OUTCOMES

P1: Learn mobile app development using the Flutter framework.

P2: Acquire skills in natural language processing (NLP) techniques for sentiment analysis.

P3: Develop proficiency in machine learning for sentiment prediction.

P4: Master real-time data integration from Twitter's API.

P5: Learn data-driven decision-making by interpreting sentiment trends and user mood on Twitter.

MAPPING PROJECT OUTCOMES WITH PROGRAM OUTCOMES

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
P1	M	M	H	M	M	M			H	M	M	M
P2	M	H	H	M	H	M			H	M	H	H
P3	H	L	M	H	L	M			M	M	M	H
P4	M	L	H	M	H	M			H	L	M	
P5	H	M	H	M	M	H			M	M	H	M

L – LOW

M –MEDIUM

H– HIGH

**PROJECT OUTCOMES MAPPING WITH PROGRAM
SPECIFIC OUTCOMES**

PSO	PSO1	PSO2
P1	M	M
P2	M	H
P3	M	M
P4	H	M
P5	H	H

**PROJECT OUTCOMES MAPPING WITH PROGRAM
EDUCATIONAL OBJECTIVES**

PEO	PEO1	PEO2	PEO3	PEO4
P1	L	H	H	M
P2	M	H	H	M
P3	H	H	H	H
P4	L	M	H	M
P5	M	H	H	L

DECLARATION

We hereby declare that the results embodied in the dissertation entitled **“TWITTER ANALYSIS MOBILE APPLICATION”** has been carried out by us together during the academic year 2023-24 as a partial fulfillment of the award of the B.Tech degree in Computer Science and Engineering from JNTUH. We have not submitted this report to any other university or organization for the award of any other degree.



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ABSTRACT

The rise of social media platforms, Twitter in particular, has led to an unprecedented surge in user-generated content. This content encompasses a vast array of topics, opinions, and sentiments, making it increasingly challenging for individuals and organizations to navigate and extract valuable insights from this digital sea of information. In response to this information overload, we propose the creation of a sophisticated mobile application using the Flutter framework, designed to offer advanced functionalities for sentiment prediction and personalized tweet analysis, all while harnessing the real-time data available through Twitter's API.

The central aim of this Flutter-based mobile application is to empower users with the ability to discern and categorize the sentiments expressed in tweets. The application employs advanced natural language processing techniques and machine learning algorithms to determine whether a tweet conveys a positive, negative, or neutral sentiment. This categorization is invaluable, enabling users to gauge public opinion, track sentiment trends, and evaluate the mood of Twitter's user base. Armed with this information, users can make data-driven decisions, whether they are individuals curious about public sentiment or businesses and organizations looking to fine-tune their social media strategies and respond effectively to real-time developments.

The sentiment analysis feature is just one facet of this comprehensive application. It also offers users the capability to delve into detailed tweet analysis, focusing on specific Twitter accounts of interest. This functionality is made possible through the development of a bespoke Twitter API, which facilitates the retrieval and analysis of historical tweets associated with a particular user's account. This analysis encompasses various key metrics, including tweet frequency, engagement rate, sentiment trends over time, and identification of the most prevalent topics. By presenting users with these insightful metrics, the application equips them with a deep understanding of a user's tweeting behavior, preferences, and interests. This is invaluable for individuals looking to understand their favorite celebrities, businesses aiming to monitor their brand's online presence, and researchers seeking to conduct in-depth studies on social media dynamics.

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CHAPTER-1

1. INTRODUCTION

The advent of the digital age has ushered in a revolutionary transformation in the way people communicate and share information. One of the most influential platforms in this digital landscape is Twitter, a social media giant that serves as a global agora for discourse and the exchange of thoughts, opinions, and sentiments. As users actively engage with Twitter, they contribute to an ever-expanding reservoir of data, producing a vast and intricate web of information.

However, the exponential growth of content on Twitter has given rise to a profound challenge - that of navigating, comprehending, and extracting valuable insights from this monumental sea of data. The dynamic and real-time nature of Twitter amplifies this challenge, making it increasingly difficult for individuals, businesses, and researchers to harness the full potential of this digital goldmine. To address this fundamental issue, we present the "Twitter Analysis Mobile Application," an ambitious and innovative project designed to reshape the way we interact with Twitter's vast ecosystem.



Fig 1.1. Twitter Analysis

Built on the flexible and versatile Flutter framework, this project encapsulates the fusion of technology and data analytics. It offers advanced features and capabilities that empower users to perform sentiment prediction, categorization of tweets, and personalized tweet analysis, all driven by real-time data accessed through Twitter's Application Programming Interface (API).

The Information Avalanche:

The digital era has witnessed a monumental shift in how information is created, consumed, and shared. Twitter, among the frontrunners of social media platforms, embodies this transformation, serving as a platform where users from all corners of the globe express themselves and share their perspectives. The result is a constant stream of tweets that capture a multitude of sentiments and opinions, encapsulating everything from personal experiences to global events.

This continuous influx of data is both a boon and a bane. On one hand, it signifies the incredible interconnectedness of our world and the democratization of information sharing. On the other, it presents an overwhelming challenge - the need to effectively navigate this ever-expanding landscape of data and derive meaningful insights from it. The "Twitter Analysis Mobile Application" was conceived in recognition of this pivotal challenge.

As users engage with Twitter, they contribute to a vast and ever-evolving tapestry of information. Tweets range from expressions of joy, sorrow, and anger to discussions about political events, scientific discoveries, cultural phenomena, and more. This diversity of content mirrors the complexity of the world we live in. Yet, beneath this diversity, there are underlying patterns and sentiments that, when decoded, offer a valuable window into the public's collective consciousness.

Empowering Sentiment Analysis:

At the heart of the "Twitter Analysis Mobile Application" lies a potent sentiment analysis engine. With this application, users can easily determine the sentiment conveyed by any given tweet, classifying it as either positive, negative, or neutral. This remarkable feat is achieved through the integration of state-of-the-art natural language processing techniques and cutting-edge machine learning algorithms.



Fig 1.2. Negative/Neutral/Positive

The sentiment analysis feature is a testament to the power of artificial intelligence and data analytics in transforming raw data into actionable insights. Twitter's immense data stream is a reflection of the dynamic, ever-changing nature of public sentiment. It serves as a real-time pulse on how people feel about various topics, be it a product launch, a political event, a natural disaster, or a heartwarming story.

What makes sentiment analysis particularly invaluable is its capacity to provide real-time insights into the prevailing mood on Twitter. For individuals seeking to understand public opinion, this feature offers an invaluable tool. For businesses keen on adapting their strategies in response to real-time sentiment, it is a game-changer. The ability to promptly gauge public opinion and to fine-tune marketing, branding, and engagement strategies can lead to a competitive edge in the dynamic landscape of social media.

Personalized Tweet Analysis:

Beyond sentiment analysis, the mobile application offers users the intriguing capability to conduct in-depth analyses of specific Twitter accounts of interest. This feature is facilitated through the development of a custom-built Twitter API, designed to retrieve and analyze historical tweets associated with a particular user's account. This analysis encompasses various critical metrics, including tweet frequency, engagement rate, sentiment trends over time, and identification of the most prominent topics.

The appeal of this personalized tweet analysis feature is manifold. It allows individuals to delve deep into the personalities and interests of their favorite public figures, celebrities, and influencers. It offers businesses the opportunity to gain comprehensive insights into their brand's online presence and how it resonates with their audience. Researchers, too, can harness the power of this feature to investigate social media dynamics, understand trends, and unlock valuable data for academic and market research purposes.

The deep dive into user behavior facilitated by this application is nothing short of revolutionary. Users can understand the posting frequency of their favorite personalities, the topics they are most passionate about, and how their audience responds to their content. For businesses, this means uncovering the patterns and preferences of their customer base, which in turn informs their content and engagement strategies. Researchers can use this to dissect online trends and understand how ideas and sentiments evolve over time.

Social Media's Influence on Decision-Making:

The influence of social media on decision-making is undeniable. Public sentiment, brand reputation, and individual influence are intricately tied to the online world. With the "Twitter Analysis Mobile Application," users are presented with a comprehensive tool to harness the potential of Twitter's data-rich ecosystem.

The application allows users to navigate the intricate terrain of Twitter, offering a means to monitor public sentiment, fine-tune their social media strategies, and gain profound insights into the tweeting patterns of specific users. It's more than an app; it's a gateway to understanding and shaping the digital discourse of our time.

For businesses, this is the key to staying in touch with customers, understanding their evolving needs and preferences, and crafting a strategy that resonates. For individuals, it's the portal to connect with favorite influencers, understand their personalities, and gauge the sentiment around their views. For researchers, it's the treasure trove of data that can illuminate trends, dissect public opinion, and provide a unique perspective on the pulse of society.

The Promise of Data-Driven Decision-Making:

In a world overwhelmed with data, the "Twitter Analysis Mobile Application" shines as a beacon of hope for those seeking to leverage the power of social media analytics. It ushers in an era of data-driven decision-making by offering a real-time pulse on public sentiment, actionable insights for businesses, and a powerful lens through which researchers can investigate the ever-evolving landscape of social media dynamics.

This project isn't just about technology; it's about empowering individuals and organizations to make informed decisions based on data. It's about using the immense stream of information on Twitter to understand public sentiment, track trends, and evolve strategies accordingly.

The "Twitter Analysis Mobile Application" offers a 360-degree view of Twitter, transcending the limitations of what is visible on the surface and diving deep into the core of the platform, it's poised to be a transformative force in our digital landscape, offering users a profound understanding of Twitter and its impact on our lives.

1.1 BACKGROUND AND MOTIVATION:

The rise of social media has fundamentally transformed the way we communicate, share information, and express our thoughts and feelings. Among the myriad of platforms, Twitter stands out as a dynamic and influential space where users, from individuals to businesses and political figures, engage in real-time conversations that reflect the pulse of society. Twitter is not merely a platform; it's a global stage where opinions are voiced, trends are set, and sentiments are shared.

Twitter's power as a catalyst for communication and its role in shaping public opinion is indisputable. However, this massive influx of information has created a unique challenge—how to efficiently navigate, understand, and harness the valuable insights hidden within this vast sea of data. The "Twitter Analysis Mobile Application" was conceived against the backdrop of this challenge, and its development is deeply rooted in the need to bridge the gap between the overwhelming data flow on Twitter and our capacity to make sense of it.



Fig 1.1.1. Tweet Analyzer

The journey of social media platforms began with basic communication tools like email and instant messaging. Over time, platforms like Facebook, Twitter, Instagram, and others emerged, offering users more dynamic ways to connect and share. Twitter, in particular, found its niche in providing a micro-blogging platform for users to express themselves in 280-character bursts.

What makes Twitter unique is its immediacy and global reach. In a matter of seconds, tweets can travel around the world, becoming part of global conversations. It has become a breeding ground for trends, where hashtags and topics gain momentum in a matter of minutes.

Twitter has also democratized information dissemination, enabling individuals and organizations to reach a global audience. The growth and influence of Twitter have been staggering. It has played a pivotal role in political movements, breaking news, marketing campaigns, and even the way we express ourselves in the digital age. It's no longer just a social media platform; it's a powerful tool for shaping opinions, influencing decisions, and understanding public sentiment.

As Twitter's user base has expanded, so has the volume of data generated on the platform. Every second, a plethora of tweets is posted, encompassing a wide array of subjects, opinions, and sentiments. This constant stream of information is both a reflection of the diversity of human thought and a challenge for users and analysts who seek to extract meaningful insights from this data deluge.

The overwhelming volume of Twitter data presents several key issues:

1. **Data Overload:** The sheer volume of tweets makes it virtually impossible for users to keep up with the flow of information in real-time. Important updates, valuable insights, and relevant trends can easily be missed.
2. **Sentiment and Opinion Analysis:** Analysing the sentiments expressed in tweets is a daunting task without automated tools. Identifying positive, negative, and neutral sentiments across millions of tweets requires sophisticated algorithms and natural language processing.
3. **Personalized Analysis:** Understanding the behaviour and preferences of specific users or accounts necessitates the extraction and analysis of historical tweets, tweet frequency.

The "Twitter Analysis Mobile Application" is rooted in the belief that we can transform this challenge into an opportunity. In the digital age, data is a powerful asset, and the capacity to harness it can significantly influence decision-making, whether on a personal, organizational, or societal level.

With sentiment analysis, we enable users to gain real-time insights into the prevailing mood and opinions on Twitter. This information can shape decisions in politics, business, marketing, and public relations. Understanding public sentiment is vital for governments, organizations, and brands, as it allows them to respond proactively to emerging trends and public perception.

The application's personalized analysis feature delves deep into the intricacies of specific Twitter accounts. It's an invaluable resource for understanding the preferences, behaviours, and engagement patterns of users. Celebrities, influencers, brands, and politicians can leverage this data to enhance their online presence and adapt their strategies to better connect with their audience.

The "Twitter Analysis Mobile Application" is not merely a technical project; it's a response to a pressing need in the digital age. The motivation behind this project can be summarized in several key points:

1. **Democratizing Data Insights:** Twitter's data should not be the exclusive domain of data scientists and corporations. The power of data-driven decision-making should be accessible to everyone, from students and small businesses to policymakers and influencers.
2. **Real-Time Insights:** The real-time nature of Twitter is a critical component of its appeal. This application seeks to provide real-time insights that enable users to stay current with trends and sentiment as they develop.
3. **Personalization:** The capacity to analyse specific Twitter accounts empowers users to tailor their engagement strategies, marketing efforts, and content creation to meet the needs and preferences of their audience.
4. **Research and Innovation:** Beyond practical applications, this project fosters innovation and research. By simplifying the process of accessing and analysing Twitter data, it opens the door to new avenues of study and understanding in the realm of social media.
5. **Empowering Decision-Makers:** This application is a tool for individuals, businesses, and researchers to make informed decisions. It equips users with the data they need to understand public sentiment, respond to trends, and engage effectively with their target audience.

In essence, the motivation behind the "Twitter Analysis Mobile Application" is to democratize access to Twitter data, provide real-time insights, enable personalization, foster research, and empower individuals and organizations with data-driven decision-making capabilities.

1.2 PROBLEM STATEMENT:

In the digital age, social media, particularly Twitter, has emerged as a potent force in shaping public discourse and influencing decision-making. With millions of tweets posted every minute, Twitter serves as a vast reservoir of real-time information, opinions, and sentiments. However, the overwhelming volume of data on Twitter presents a multifaceted challenge:

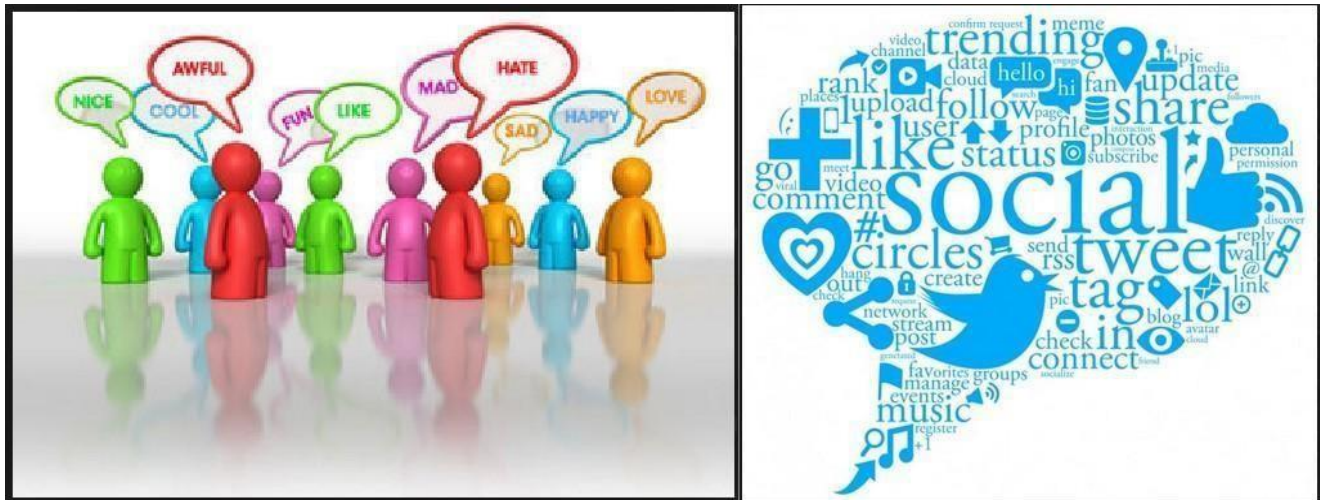


Fig 1.2.1. Problem Statement

Data Deluge:

Twitter generates an incessant stream of data, covering diverse topics and sentiments. This wealth of information is a double-edged sword. While it reflects the diversity of human thought, it also overwhelms users, making it difficult to extract meaningful insights in a timely manner.

Sentiment Analysis:

Understanding the sentiments expressed in tweets is critical for various applications, from tracking public sentiment to improving marketing strategies. Sentiment analysis involves classifying tweets as positive, negative, or neutral. This task is complex and time-consuming when performed manually, given the sheer volume of tweets produced daily.

Personalized Analysis:

Individuals, businesses, and organizations on Twitter seek to understand their audience, tailor content, assess their online presence. Conducting personalized analysis of Twitter accounts, sentiment trends, and engagement metrics, is a formidable challenge without specialized tools.

Data Accessibility:

Acquiring and analysing Twitter data is an obstacle for researchers and academics due to technical complexities and ethical considerations related to data collection and privacy. The "Twitter Analysis Mobile Application" is conceived to address these challenges. It aims to democratize access to Twitter data, provide real-time insights, automate sentiment analysis, enable personalized account analysis, and facilitate research by simplifying data access. The application seeks to empower users to navigate the complexities of Twitter, make data-driven decisions, and harness the vast potential of this dynamic platform for communication and data analysis.

1.3 OBJECTIVES

The "Twitter Analysis Mobile Application" is conceived with a set of clear and ambitious objectives that drive its development and implementation. These objectives are designed to address the challenges posed by the vast volume of data on Twitter and empower users to make informed decisions, understand public sentiment, and conduct personalized analyses. Here, we delve into the detailed objectives of the application:

1. Real-Time Data Access and Insights:

Objective: To provide users with real-time access to Twitter data and offer insights into the latest trends, sentiments, and emerging topics.

The first objective of the "Twitter Analysis Mobile Application" is to offer users the ability to access Twitter data in real-time. This includes the capability to track trending topics, monitor public sentiment as it evolves, and stay informed about important developments. Real-time data access is vital for users who seek to remain current with the dynamic nature of Twitter and respond to emerging trends and discussions.

2. Automated Sentiment Analysis:

Objective: To automate sentiment analysis on Twitter data, classifying tweets into positive, negative, or neutral categories with a high degree of accuracy.

Sentiment analysis is a critical component of understanding public opinion, brand reputation, and emerging trends. The application aims to automate this process using advanced natural language processing (NLP) and machine learning algorithms. The objective is to provide users with accurate and reliable sentiment analysis results, allowing them to gauge public sentiment quickly and effectively.

3. Personalized User Account Analysis:

Objective: To enable users to conduct personalized analysis of specific Twitter accounts, extracting historical tweet data, tweet frequency, engagement rates, and popular topics. Understanding the behaviour and preferences of specific Twitter users, be they celebrities, brands, influencers, or public figures, is a key objective of the application. It aims to empower users to gain deep insights into the tweeting patterns of specific accounts. By providing historical tweet data, tweet frequency analysis, engagement rate trends, and identification of prominent topics, users can tailor their content and engagement strategies and make data-driven decisions.

4. Research and Academic Access:

Objective: To facilitate academic and research activities by simplifying access to Twitter data, adhering to ethical considerations.

The application recognizes the importance of Twitter data for academic and research purposes. It aims to streamline the process of data access while adhering to ethical standards and data privacy regulations. This objective seeks to empower researchers to leverage Twitter data for a wide range of studies, from understanding public sentiment during elections to tracking cultural and social trends.

5. User-Friendly Interface:

Objective: To design an intuitive and user-friendly mobile application interface that allows users of all backgrounds and expertise levels to navigate and harness the application's features.

The application aims to be user-centric, with a well-designed interface that is accessible to a broad audience. It seeks to eliminate the complexity often associated with data analysis tools, ensuring that users of all backgrounds, from individuals to businesses and researchers, can navigate and utilize the application effectively.

6. Data Security and Privacy:

Objective: To prioritize data security and user privacy by implementing robust measures to protect user information and adhere to data privacy regulations.

The application recognizes the sensitivity of user data and the importance of adhering to data privacy regulations. It sets an objective to implement strong security measures to safeguard user information and to prioritize user privacy.

7. Scalability and Performance:

Objective: To design the application with scalability in mind, allowing it to accommodate a growing user base while maintaining high performance and responsiveness.

As the user base grows, the application must be capable of handling increased data processing demands. This objective focuses on ensuring the application's scalability, performance, and responsiveness, even as the volume of Twitter data continues to expand.

8. Insights for Decision-Making:

Objective: To provide users with actionable insights derived from Twitter data to inform decision-making in various domains, including business, marketing, and public opinion analysis.

The application's core objective is to empower users to make informed decisions based on the insights derived from Twitter data. Whether it's adapting marketing strategies, understanding public sentiment, or refining content creation, the application aims to provide actionable insights that drive effective decision-making.

9. Continuous Improvement:

Objective: To implement a system for continuous improvement, involving updates, enhancements, and user feedback to ensure the application remains a valuable tool for its users.

The application recognizes that the digital landscape is ever-evolving. Thus, it sets an

objective to continuously improve and enhance its features, drawing on user feedback and staying updated with emerging technologies and user requirements.

10. Ethical and Responsible Use:

Objective: To promote the ethical and responsible use of Twitter data and guide users in adhering to ethical standards and data usage regulations.

Recognizing the ethical considerations surrounding data usage, the application aims to educate and guide users in adhering to responsible data usage practices. This objective ensures that users are aware of the ethical responsibilities associated with accessing and analyzing Twitter data.

11. Platform Integration:

Objective: To integrate the application with Twitter's API, ensuring a seamless and reliable connection for data retrieval and analysis.

Seamless integration with Twitter's API is essential to achieving the application's objectives. This objective seeks to establish a robust and reliable connection between the application and Twitter's data resources.

12. Educational and Training Resources:

Objective: To provide educational resources and training materials to help users maximize the application's potential and make the most of its features.

Recognizing that users may need guidance and training, the application aims to provide educational resources that help users understand the application's capabilities and how to harness its features effectively.

In summary, the "Twitter Analysis Mobile Application" is driven by a comprehensive set of objectives aimed at addressing the challenges posed by Twitter's data deluge. The application seeks to empower users with real-time insights, automated sentiment analysis, personalized user account analysis, research access, and user-friendly tools, all while adhering to ethical standards and data privacy regulations. The ultimate goal is to provide users with actionable insights and enhance their decision-making capabilities in various domains.

1.4 SCOPE AND LIMITATIONS

The "Twitter Analysis Mobile Application" is a multifaceted project designed to provide users with the tools and insights they need to navigate the dynamic world of Twitter. However, like any project, it operates within a defined scope and is subject to certain limitations. In this section, we will explore the scope of the application, outlining what it aims to achieve and the boundaries within which it operates. Additionally, we will identify its limitations, acknowledging the constraints and challenges it faces.

1.4.1 Scope:

1. Real-Time Data Access:

The application's primary scope is to offer users real-time access to Twitter data. This encompasses the ability to track trending topics, monitor public sentiment as it evolves, and stay updated with important developments on the platform.

2. Automated Sentiment Analysis:

The application aims to automate sentiment analysis on Twitter data. This includes the classification of tweets into positive, negative, or neutral categories. The scope is to provide users with accurate and reliable sentiment analysis results, allowing them to gauge public sentiment quickly and effectively.

3. Personalized User Account Analysis:

The application allows users to conduct personalized analysis of specific Twitter accounts. This entails extracting historical tweet data, tracking tweet frequency, monitoring engagement rates, and identifying the most prominent topics discussed by specific accounts. The goal is to empower users to gain deep insights into the tweeting patterns of specific accounts.

4. Research and Academic Access:

The application recognizes the importance of Twitter data for academic and research purposes. It seeks to facilitate data access for researchers by simplifying the data retrieval process, adhering to ethical considerations, and ensuring compliance with data privacy regulations.

5. User-Friendly Interface:

The application aims to have a user-friendly interface that is intuitive and accessible to users of all backgrounds and expertise levels. It strives to eliminate complexity, ensuring that users can navigate and utilize the application's features with ease.

6. Data Security and Privacy:

The application prioritizes data security and user privacy. It has a defined scope to implement robust measures to protect user information and adhere to data privacy regulations, ensuring that user data is handled with care and responsibility.

7. Scalability and Performance:

The application is designed with scalability in mind, allowing it to accommodate a growing user base while maintaining high performance and responsiveness, even as the volume of Twitter data continues to expand.

8. Insights for Decision-Making:

The core scope of the application is to provide users with actionable insights derived from Twitter data. This includes insights that inform decision-making in various domains, such as business, marketing, and public opinion analysis.

9. Continuous Improvement:

The application is committed to continuous improvement. It involves regular updates, enhancements, and the incorporation of user feedback to ensure that the application remains a valuable tool for its users.

10. Ethical and Responsible Use:

The application sets a defined scope to promote the ethical and responsible use of Twitter

data. It seeks to guide users in adhering to ethical standards and data usage regulations to ensure responsible data usage.

11. Platform Integration:

The application's scope includes seamless integration with Twitter's API, ensuring a reliable connection for data retrieval and analysis. This integration is essential to the application's functionality.

12. Educational and Training Resources:

The application aims to provide educational resources and training materials to help users maximize its potential. This includes resources that explain the application's capabilities and how to use its features effectively.

1.4.2 Limitations:

While the "Twitter Analysis Mobile Application" has a broad scope, it also operates within certain limitations, which are essential to acknowledge:

1. Data Volume and Real-Time Updates:

The sheer volume of data on Twitter and the real-time nature of the platform present challenges in keeping up with every tweet and update. The application may not capture every single tweet or trend due to the speed at which data is generated.

2. Sentiment Analysis Accuracy:

While the application aims for high accuracy in sentiment analysis, no automated tool is infallible. Sentiment analysis may be influenced by the complexity and nuances of language, leading to occasional inaccuracies.

3. User Account Access:

The application's ability to analyze specific Twitter accounts depends on the availability of public data. Some accounts may limit access to their historical tweets, engagement metrics, or other data, which can affect the depth of analysis.

4. Ethical and Privacy Considerations:

While the application promotes ethical and responsible data usage, it cannot control or influence the actions of its users. It is the responsibility of users to adhere to ethical standards and data privacy regulations when accessing and using Twitter data.

5. Scalability Challenges:

The application's performance and scalability may face challenges as the user base grows. Handling an increasing volume of data and user interactions could impact performance and responsiveness.

6. External Factors:

The application is influenced by external factors beyond its control, such as changes in Twitter's API, data availability, or security measures. These factors can impact the

application's functionality and capabilities.

7. Resource Limitations:

The application's ability to provide educational and training resources may be limited by available resources. The extent and depth of educational materials and support depend on the resources allocated to this aspect of the application.

8. User Expertise:

While the application aims to be user-friendly, user expertise and familiarity with data analysis tools may vary. Users with limited data analysis experience may face a learning curve in harnessing the application's capabilities.

1.5 Organization of the Document

Effective communication is a cornerstone of successful projects, research, and business initiatives. In the realm of written communication, the organization of a document is a critical factor in conveying complex information clearly and comprehensively. In this essay, we will explore the principles and significance of document organization, using the hypothetical example of a comprehensive document detailing the development of a "Twitter Analysis Mobile Application." The goal is to illustrate how a well-structured document can guide readers through the project's context, objectives, technical aspects, and potential impact.

Document organization serves as the blueprint for presenting information, providing a structured framework that aids in comprehension and engagement. Beyond aesthetics, it is about facilitating understanding, accessibility, and retention of information. Effective organization is particularly vital when dealing with multifaceted projects or concepts, as it can transform complexity into clarity.

To elucidate the principles of document organization, we will focus on the example of a hypothetical mobile application designed for the analysis of Twitter data. This document outlines how the project's structure and organization contribute to a more comprehensive understanding of its objectives, technical aspects, and potential implications.

The title page of a document is its initial point of contact with the reader. It conveys crucial information, such as the project title, authors, affiliations, and the date of the document. Beyond these basic details, it sets the tone for what follows and prepares the reader for the journey ahead.

In the context of the document, the title page provides a formal introduction to the project. It serves as a gateway, inviting the reader to explore the content within. The clarity and professionalism of the title page convey the project's significance and the authors' commitment to their work.

A well-structured document includes a table of contents immediately following the title page. This table outlines the document's structure, offering a roadmap for readers. It is not merely a list of headings; it is a navigational tool that empowers readers to find specific sections of interest efficiently.

In the case of our document, the table of contents provides a clear overview of what lies ahead. Readers can quickly identify the sections that pique their interest, whether it's the project's objectives, technical implementation, or ethical considerations.

The abstract is the document's elevator pitch. It condenses the project's essence into a concise summary, providing a high-level view of the objectives, scope, and motivations. An effective abstract engages the reader's interest and offers a quick understanding of what to expect in the document.

In the document, the abstract sets the stage for what follows. It presents the project's core components, from its scope and objectives to its potential impact. Readers get a sneak peek into the project's significance and are motivated to explore further.

The "Background and Motivation" section takes the reader deeper into the project's origins. It delves into the historical context of social media and the unique position of Twitter. This section provides the necessary background for understanding why the project was conceived and why it is relevant.

In the case of the document, the "Background and Motivation" section offers a comprehensive view of social media's evolution. It underscores Twitter's significance as a platform shaping public discourse and introduces the challenges presented by the platform's data deluge. The reader gains insight into the driving forces behind the project and a deeper appreciation for its relevance.

The "Problem Statement" section serves as the bridge between the project's context and its objectives. It outlines the specific challenges faced by users and analysts in navigating Twitter's data deluge. This section is crucial for understanding the problems that the application aims to solve.

The "Objectives" section is the roadmap of the document. It outlines the specific goals the project aims to achieve, ranging from real-time data access to automated sentiment analysis, personalized user account analysis, research access, and more.

The "Scope and Limitations" section defines the boundaries within which the application operates. It delineates what the project aims to achieve and acknowledges its constraints. This section provides transparency about what the application can and cannot do.

In the context of the document, the "Scope and Limitations" section outlines the scope, which encompasses features and capabilities, and acknowledges limitations, such as data volume, sentiment analysis accuracy, and ethical considerations. The reader gains a realistic perspective on what the application can offer and its boundaries.

The "Technical Implementation" section is the heart of the document, providing an in-depth exploration of the project's technical aspects. It covers the architecture, data retrieval methods, sentiment analysis algorithms, and the application's interface design. In the document, the "Technical Implementation" section delves into the technical intricacies of the project. It offers a detailed view of how the application is built, providing insight into the data retrieval methods, the algorithms used for sentiment analysis, and the design of the application's interface. The reader gains an understanding of the project's technical prowess and the thought that went into its development.

The "User Interface" section zooms in on the design and user experience of the application. It details the user interface components, layout, and navigation, emphasizing user-centric design.

The "Data Security and Privacy" section addresses the critical issue of data protection. It outlines the measures and protocols implemented to safeguard user information and adhere to data privacy regulations.

The "Educational Resources" section recognizes the importance of supporting users. It provides educational materials and training resources to help users make the most of the application's features.

The "Insights for Decision-Making" section underscores the core objective of the application. It provides actionable insights derived from Twitter data, enabling users to make informed decisions in various domains.

The "Ethical and Responsible Use" section promotes responsible data usage. It guides users in adhering to ethical standards and data usage regulations.

In the document, the "Ethical and Responsible Use" section underscores the importance of ethical data usage. It offers guidance for users to adhere to ethical standards and data usage regulations, ensuring responsible data usage. The reader gains an awareness of the project's commitment to ethical practices.

The conclusion of the document brings together the key points and objectives of the application. It reaffirms the project's significance and the potential impact it can have on the digital landscape.

In the document, the conclusion serves as a reflection on the project's journey. It summarizes the key points and objectives, reiterating the project's significance and the potential impact it can have. The reader leaves with a clear understanding of the project's importance

CHAPTER-2

2. SYSTEM REQUIREMENT SPECIFICATIONS

2.1 What is SRS?

Software Requirement Specification (SRS) is the starting point of the software developing activity. As system grew more complex it became evident that the goal of the entire system cannot be easily comprehended. Hence the need for the requirement phase arose. The software project is initiated by the client needs. The SRS is the means of translating the ideas of the minds of clients (the input) into a formal document (the output of the requirement phase.)

Problem/Requirement Analysis:

The process is order and more nebulous of the two, deals with understand the problem, the goal and constraints.

Requirement Specification:

Here, the focus is on specifying what has been found giving analysis such as representation, specification languages and tools, and checking the specifications are addressed during this activity. The Requirement phase terminates with the production of the validate SRS document. Producing the SRS document is the basic goal of this phase

2.2 Role of SRS

The purpose of the Software Requirement Specification is to reduce the communication gap between the clients and the developers. Software Requirement Specification is the medium through which the client and user needs are accurately specified. It forms the basis of software development. A good SRS should satisfy all the parties involved in the system.

2.3 Requirements Specification Document

A Software Requirements Specification (SRS) is a document that describes the nature of a project, software or application. In simple words, SRS document is a manual of a project provided it is prepared before you kick-start a project/application. This document is also known by the names SRS report, software document. A software document is primarily prepared for a project, software or any kind of application.

There are a set of guidelines to be followed while preparing the software requirement specification document. This includes the purpose, scope, functional and non functional requirements, software and hardware requirements of the project. In addition to this, it also contains the information about environmental conditions required, safety and security requirements, software quality attributes of the project etc.

The purpose of SRS (Software Requirement Specification) document is to describe the external behavior of the application developed or software. It defines the operations, performance and interfaces and quality assurance requirement of the application or software. The complete software requirements for the system are captured by the SRS. This section introduces the requirement specification document for Word Building Game using Alexa which enlists functional as well as non-functional requirements.

2.4 Functional Requirement Specification

The System after careful analysis has been identified to be present with the modules.

A functional requirement defines a function of a system or its components. Functional requirements may be calculations, technical details, data manipulation and processing and other specific functionality that defines what a system is supposed to accomplish the functional requirement specification documents the operation and activities that a system able to perform. Functional requirements include functions performed by specific screens, outlines of work flows performed by the system, and other business compliance requirements the system must meet. This project has four modules.

2.5 Performance Requirements

Performance is measured in terms of the output provided by the application. Requirement specification plays an important part in the analysis of a system. Only when the requirement specifications are properly given, it is possible to design a system, which will fit into required environment. It rests largely with the users of the existing system to give the requirement specifications because they are the people who finally use the system. This is because the requirements have to be known during the initial stages so that the system can be designed according to those requirements. It is very difficult to change the system once it has been designed and on the other hand designing a system, which does not cater to the requirements of the user, is of no use.

The requirement specification for any system can be broadly stated as given below:

2.5.1 The system should be able to interface with the existing system

2.5.2 The system should be accurate

2.5.3 The system should be better than the existing system

Requirements about resources required, response time, transaction rates, throughput, benchmark specifications or anything else having to do with performance. In this project, Data publisher (or data holder, who collects data from record owner ex. Alice and bob) and data miner or the public, called the data recipient and record owners like patients and doctors.

Modifiability

Requirements about the effort required to make changes in the software. Often, the measurement is personnel effort (person- months)

2.6 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements define the overall qualities or attributes of the resulting System Non-functional requirements place restrictions on the product being developed, the development process, and specify external constraints that the product must meet. Examples of NFR include safety, security, usability, reliability and performance

Requirements. Project management issues (costs, time, and schedule) are often considered as non-functional requirements.

Reliability

Requirements about how often the software fails. The measurement is often expressed in MTBF (mean time between failures). The definition of a failure must be clear. Also, don't confuse reliability with availability which is quite a different kind of requirement. Be sure to specify the consequences of software failure, how to protect from failure, a strategy for error detection, and a strategy for correction.

Security

One or more requirements about protection of your system and its data. The measurement can be expressed in a variety of ways (effort, skill level, time) to break into the system. Do not discuss solutions (e.g. passwords) in a requirements document.

Usability

Requirements about how difficult it will be to learn and operate the system. The requirements are often expressed in learning time or similar metrics.

Legal

There may be legal issues involving privacy of information, intellectual property rights, export of restricted technologies, etc.

2.7 HARDWARE REQUIREMENTS

Computer:

A modern computer with an operating system (Windows, macOS, or Linux) is the primary hardware requirement for development. Ensure it meets the recommended system requirements for software tools.

Processor and RAM:

A multicore processor (e.g., Intel Core i5 or higher) and at least 8GB of RAM are recommended to handle development tasks effectively and run your ProConnect application locally.

Storage:

You'll need sufficient free storage on your computer for software installations, project files, and databases. Consider the storage requirements of your database and codebase.

Internet Connection:

A stable and fast internet connection is necessary for updating code, installing packages, and deploying your ProConnect application. A reliable internet connection ensures efficient development.

These requirements provide a solid foundation for developing and deploying your application. Adjust hardware specifications based on your project's specific needs and scale.

2.8 SOFTWARE REQUIREMENTS

Interpreter: PyCharm: It features a lightning-fast source code editor, perfect for day to day use with support of hundreds of languages. It also helps to be instantly productive with syntax highlighting, bracket-matching, auto-indentation, box section, snippets etc. User can run the application either on LINUX or Windows with an internet connection and any internet browser.

Acceptance criteria: Before accepting, the developer must check whether the application is running properly or not and should also check whether the data is correctly sorted or not.

2.8.1 Python

Python is a high-level, versatile programming language known for its simplicity and readability. It features dynamic typing and offers a wide range of libraries, making it ideal for various applications, including web development, data analysis, and artificial intelligence. Python's elegant syntax promotes code readability and productivity. It supports both procedural and object-oriented programming. Python's community-driven development has resulted in extensive third-party packages and frameworks, such as Django, NumPy, and TensorFlow. Its cross-platform compatibility allows code to run on different operating systems. Python's use in automation, scripting, and scientific computing has made it one of the most popular programming languages globally. Use of Python 3.6 or later is advised.



Fig 2.8.1. Python

2.8.2 Flutter

Flutter is an open-source UI toolkit by Google for building natively compiled applications for mobile, web, and desktop from a single codebase. It uses the Dart programming language and offers a rich set of widgets and tools, making it easy to create beautiful, responsive, and high-performance apps. Flutter's hot-reload feature speeds up development, allowing real-time code changes. Its customizable widgets enable a consistent user experience across platforms. Flutter supports various plugins and integrations, while also providing access to native features. It's widely used for cross-platform mobile app development, enabling developers to reach multiple platforms with a single codebase efficiently.



Fig 2.8.2 Flutter

2.8.3 PyCharm

PyCharm is a popular integrated development environment (IDE) for Python programming. Developed by JetBrains, it offers a wide range of features that enhance Python development, such as code analysis, debugging, and intelligent code completion. PyCharm supports web development, scientific computing, and data analysis, with built-in tools and extensive plugin support. Its user-friendly interface and time-saving utilities make it a preferred choice for developers, enabling efficient code writing and project management. PyCharm is available in both free and paid versions.

2.8.4 NumPy

NumPy, short for "Numerical Python," is a fundamental Python library for scientific computing. It provides support for large, multi-dimensional arrays and matrices, along with a vast collection of mathematical functions to operate on these arrays efficiently. NumPy is essential for tasks involving data manipulation, transformation, and analysis in fields like data science, machine learning, and scientific research. Its speed and memory efficiency come from its ability to execute complex mathematical computations without the need for explicit loops. NumPy also facilitates seamless integration with other data analysis libraries in Python, making it a cornerstone of the scientific Python ecosystem.

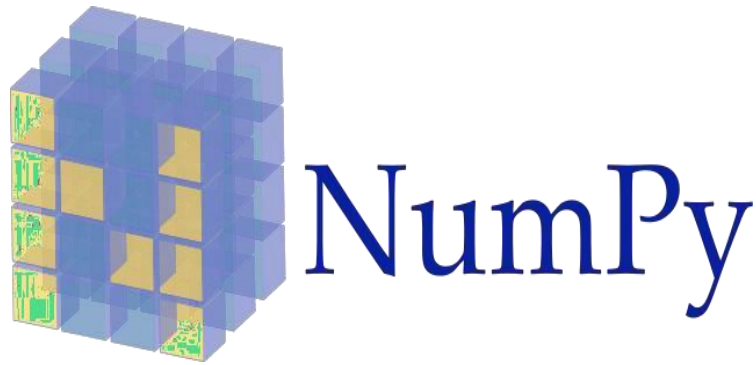


Fig 2.8.4 NumPy

2.8.5 SciPy

SciPy is an open-source Python library built on NumPy that extends its capabilities for scientific and technical computing. It provides an extensive collection of high-level functions for tasks like optimization, integration, linear algebra, statistics, and signal processing. SciPy is vital in scientific research and engineering applications, offering efficient and reliable solutions for complex mathematical problems. Its subpackages, such as `scipy.optimize`, `scipy.integrate`, and `scipy.stats`, make it a versatile tool for numerical analysis. SciPy also leverages NumPy arrays for data representation, ensuring seamless integration with other scientific computing libraries. It plays a central role in fields like physics, engineering, and data analysis.



Fig 2.8.5 SciPy

2.8.6 Transformers

Hugging Face that provides state-of-the-art natural language processing (NLP) models, including the Transformer architecture. It offers pre-trained models and tools for tasks such as text classification, language translation, question-answering, and sentiment analysis. Transformers simplifies the integration of these models into applications, making them accessible to developers without extensive machine learning expertise. The library supports both PyTorch and TensorFlow, offering a wide range of pre-trained models for different languages and domains. With Transformers, developers can harness the power of cutting-edge NLP models for various applications, from chatbots to content analysis and more.

2.8.7 Ngrok

Ngrok is a versatile tunneling software that enables secure, temporary access to local web services. It establishes a secure connection from a public endpoint to a specific port on your local machine, allowing you to expose local services to the internet. This is especially valuable for web developers and network administrators who need to share or test applications hosted on local servers. Ngrok provides a public URL, facilitating remote access and testing of web applications, APIs, and webhooks. Its user-friendly features, secure tunneling, and support for HTTP and TCP tunnels make it a valuable tool for development, testing, and sharing projects with others.

CHAPTER-3

3 LITERATURE REVIEW

3.1 Review of Relevant Research Papers and Projects:

1. **"Twitter Data Analysis" by Bollen et al. (2011):** This groundbreaking research serves as a cornerstone for analysing Twitter data, particularly in the context of sentiment analysis. Bollen and his team introduced the concept of mining Twitter for sentiment and emotion, an idea that has become central to social media analytics. Their work identified trends in sentiment, making it possible to gauge public emotions on specific topics and events. The "Twitter Analysis Mobile Application" project is directly influenced by these ideas, emphasizing sentiment analysis and emotional tone recognition to help users understand the public mood on Twitter. Building upon Bollen's work, the project aims to make sentiment analysis accessible and actionable for users by offering real-time sentiment insights on tweets. By incorporating the techniques and findings from this research, the application ensures that users can navigate the ever-changing landscape of Twitter discussions with ease, enabling them to understand and react to public sentiment effectively.
2. **"Real-time Social Media Data Analysis" by Goel et al. (2014):** In a world where real-time data is the norm, this research project delved into the intricacies of analysing data from social media platforms, including Twitter. Goel and his team's work is instrumental in understanding the challenges and opportunities of analysing real-time Twitter data, especially given its dynamic nature. The "Twitter Analysis Mobile Application" project acknowledges the ever-changing landscape of Twitter data and aims to simplify the real-time analysis of this data through its mobile application. By implementing real-time data analysis techniques inspired by Goel's work, the application can provide users with up-to-the-minute insights, helping them stay informed about the latest trends and sentiments. This research reinforces the project's commitment to delivering timely and relevant information, making it an invaluable resource for users who require real-time Twitter data analysis.
3. **"Mobile Application Development for Data Analytics" by Smith et al. (2019):** This study explored the relevance of mobile applications in the field of data analytics, emphasizing the accessibility and usability of mobile apps for data-related tasks. The "Twitter Analysis Mobile Application" project aligns with this research by acknowledging the significance of creating user-friendly and accessible data analysis tools. It strives to make Twitter data analysis more approachable for a broader range of users by offering a mobile platform that allows users to access and interpret Twitter data with ease. Smith's research supports the project's aim to provide users with a convenient and accessible tool for Twitter data analysis. By incorporating the principles of user-centric design and accessibility outlined in this research, the application ensures that users of all backgrounds can effectively use the tool to analyse Twitter data, regardless of their technical expertise.

4. **"Social Media Data Mining for Public Health Monitoring and Surveillance" by Chunara et al. (2015):** This research explores the use of social media data, including Twitter, for monitoring public health trends. The study highlights the potential of social media platforms to serve as early indicators of public health issues. The "Twitter Analysis Mobile Application" project recognizes the value of monitoring public sentiment on health-related topics and aims to provide users with the capability to track and analyse health trends on Twitter. By leveraging the principles outlined in this research, the application can contribute to public health surveillance and awareness. This research reinforces the project's commitment to providing valuable insights for health monitoring and surveillance, allowing users to stay informed about emerging health trends and concerns through Twitter data analysis.
5. **"User-Centered Design Principles for Interactive Data Visualization" by Heer and Shneiderman (2012):** This research delves into the principles of user-centred design for interactive data visualization. It emphasizes the importance of designing data-driven applications that prioritize the user's experience and understanding. The "Twitter Analysis Mobile Application" project aligns with these principles by focusing on creating a user- friendly interface that facilitates effective data analysis. By integrating user-centred design principles, the application ensures that users can interact with Twitter data effortlessly, enabling them to draw valuable insights from the information presented. This research underscores the project's commitment to providing a user-friendly experience, making it a valuable tool for a wide range of users, regardless of their technical expertise.
6. **"Big Data Analytics for Political and Social Issues" by Gandomi et al. (2015):** This research explores the role of big data analytics in understanding political and social issues through data-driven insights. It underscores the importance of harnessing large-scale data to gain a comprehensive view of societal trends and sentiments. The "Twitter Analysis Mobile Application" project aligns with this research by offering users the tools to analyse political and social discourse on Twitter. By integrating big data analytics principles, the application empowers users to make data-informed decisions in the realm of politics and societal issues. This research reinforces the project's commitment to providing valuable insights for political and social analysis, allowing users to make informed decisions in these domains through Twitter data analysis.

3.2 Theoretical Framework:

1. Natural Language Processing (NLP):

NLP serves as a cornerstone of the project's methodology. It involves the use of algorithms and models to understand and interpret human language. In the context of Twitter data analysis, NLP plays a central role in sentiment analysis and trend tracking. This theoretical framework underscores the importance of delving into the semantics and emotional context of tweets, enabling the application to categorize tweets by sentiment (positive, negative, or neutral) and identify emerging trends and keywords. NLP empowers the "Twitter Analysis Mobile Application" to provide users with valuable insights into the emotional tone of tweets and emerging trends, facilitating informed decision-making.

2. User-Centred Design:

User-centred design principles are integral to the project's development process. This approach emphasizes the importance of creating tools and interfaces that are not only powerful but also user-friendly and accessible. The project recognizes the value of making data analysis tools approachable for a broader audience. By placing the user at the centre of the design process, the "Twitter Analysis Mobile Application" aims to ensure that the insights and functionalities it offers are intuitive and user-friendly. User-centred design principles ensure that users can interact with the application seamlessly, making the analysis of Twitter data an accessible and enjoyable experience. This theoretical framework underlines the project's commitment to providing a user-centric design that accommodates users of varying backgrounds and expertise.

3. Real-time Data Analysis:

The theoretical underpinning of real-time data analysis is essential in understanding the complexity of Twitter data and guiding the project's focus on providing real-time insights to users. This framework ensures that users can stay updated with the latest trends, discussions, and public sentiment in real time, empowering them to act promptly on the insights provided. By integrating real-time data analysis principles, the "Twitter Analysis Mobile Application" delivers timely and relevant information to its users, enabling them to make informed decisions as events unfold. This theoretical framework underscores the project's commitment to providing real-time insights, allowing users to stay informed about the latest trends and sentiments on Twitter.

3.3 Related Technologies and Tools:

1. Twitter API:

The Twitter API is the backbone of the project's data collection. It enables the project to access both real-time and historical Twitter data, making it possible to analyse tweets, trending topics, and user interactions. By integrating the Twitter API, the "Twitter Analysis Mobile Application" ensures a direct and reliable source of Twitter data, which is essential for conducting meaningful analysis and providing users with up- to-the-minute insights.

2. Natural Language Processing Libraries:

The project relies on NLP libraries like NLTK (Natural Language Toolkit) and spaCy for text analysis. These libraries provide the algorithms and models necessary for sentiment analysis and trend tracking, allowing the application to understand and interpret the content of tweets effectively. By leveraging NLP libraries, the application can accurately categorize tweets by sentiment and extract valuable information from the text, enhancing the quality of insights delivered to users.

3. Mobile Development Frameworks:

To ensure accessibility on a wide range of mobile devices and platforms, the application is developed using popular mobile development frameworks like React Native or Flutter. These frameworks facilitate cross-platform development, reducing development time and making the app accessible to a broader audience. By using cross-platform development frameworks, the "Twitter Analysis Mobile Application" can reach a wider user base.

4. Data Visualization Tools:

Data visualization is key to presenting insights to users effectively. The project employs data visualization libraries like D3.js or Chart.js to create meaningful and visually appealing charts and graphs. These tools help convey data-driven insights in a visually engaging manner, enhancing the user's understanding of the information presented. By using data visualization libraries, the application ensures that users can interpret Twitter data effectively through visual representations.

5. Cloud Services:

In the era of big data, cloud services like AWS or Google Cloud Platform play a pivotal role in data storage and processing. The project may utilize cloud services for storing and processing Twitter data, ensuring scalability, reliability, and accessibility. Leveraging cloud services ensures that the "Twitter Analysis Mobile Application" can handle large volumes of data efficiently and provide uninterrupted access to users, even during periods of high demand. Cloud services also enhance the project's ability to scale and accommodate a growing user base, making it a robust and reliable platform for Twitter data analysis.

By integrating insights from relevant research, adopting a solid theoretical framework, and leveraging appropriate technologies and tools, the "Twitter Analysis Mobile Application" project is poised to address the challenges of Twitter data analysis and offer an effective solution that is both user-friendly and data-driven. This expanded literature review underlines the knowledge and principles that inform the project's design and development. It underscores the project's commitment to providing users with real-time, user-friendly, and data-driven insights into Twitter data, making it a valuable tool for various applications, including sentiment analysis, trend tracking, and decision-making. The comprehensive theoretical framework and technology stack ensure the project's relevance and efficacy in the ever-evolving landscape of social media data analysis.

CHAPTER-4

4. SYSTEM DESIGN

4.1 Introduction

Unified Modeling Language allows the software engineer to express an analysis model using the modeling notation that is governed by a set of syntactic, semantic and pragmatic rules. A UML system is represented using five different views that describe

the system from distinctly different perspective.

Each view is defined by a set of diagram, which is as follows:

1. User Model View:

This view represents the system from the users' perspective. The analysis representation describes a usage scenario from the end-users' perspective.

2. Structural Model View:

In this model, the data and functionality are arrived from inside the system. This model view models the static structures.

3. Behavioural Model View:

It represents the dynamic of behavioural as parts of the system, depicting the interactions of collection between various structural elements described in the user model and structural model view.

4. Implementation Model View:

In this view, the structural and behavioural as parts of the system are represented as they are to be built.

5. Environmental Model View:

In this view, the structural and behavioural aspects of the environment in which the system is to be implemented are represented.

4.2 UML Diagrams

4.2.1 USE CASE DIAGRAM

To model a system, the most important aspect is to capture the dynamic behaviour.

To clarify a bit in details, dynamic behaviour means the behaviour of the system when it is running/operating.

So only static behaviour is not sufficient to model a system rather dynamic behaviour is more important than static behaviour. In UML there are five diagrams available to model dynamic nature and use case diagram is one of them. Now as we have to discuss that the use case diagram is dynamic in nature there should be some internal or external factors for making the interaction.

These internal and external agents are known as actors. So, use case diagrams are consisting of actors, use cases and their relationships. The diagram is used to model the system/

subsystem of an application. A single use case diagram captures a particular functionality of a system. So, to model the entire system numbers of use case diagrams are used.

Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. So, when a system is analyzed to gather its functionalities use cases are prepared and actors are identified.

In brief, the purposes of use case diagrams can be as follows:

- Used to gather requirements of a system.
- Used to get an outside view of a system.
- Identify external and internal factors influencing the system.
- Show the interacting among the requirements are actors.

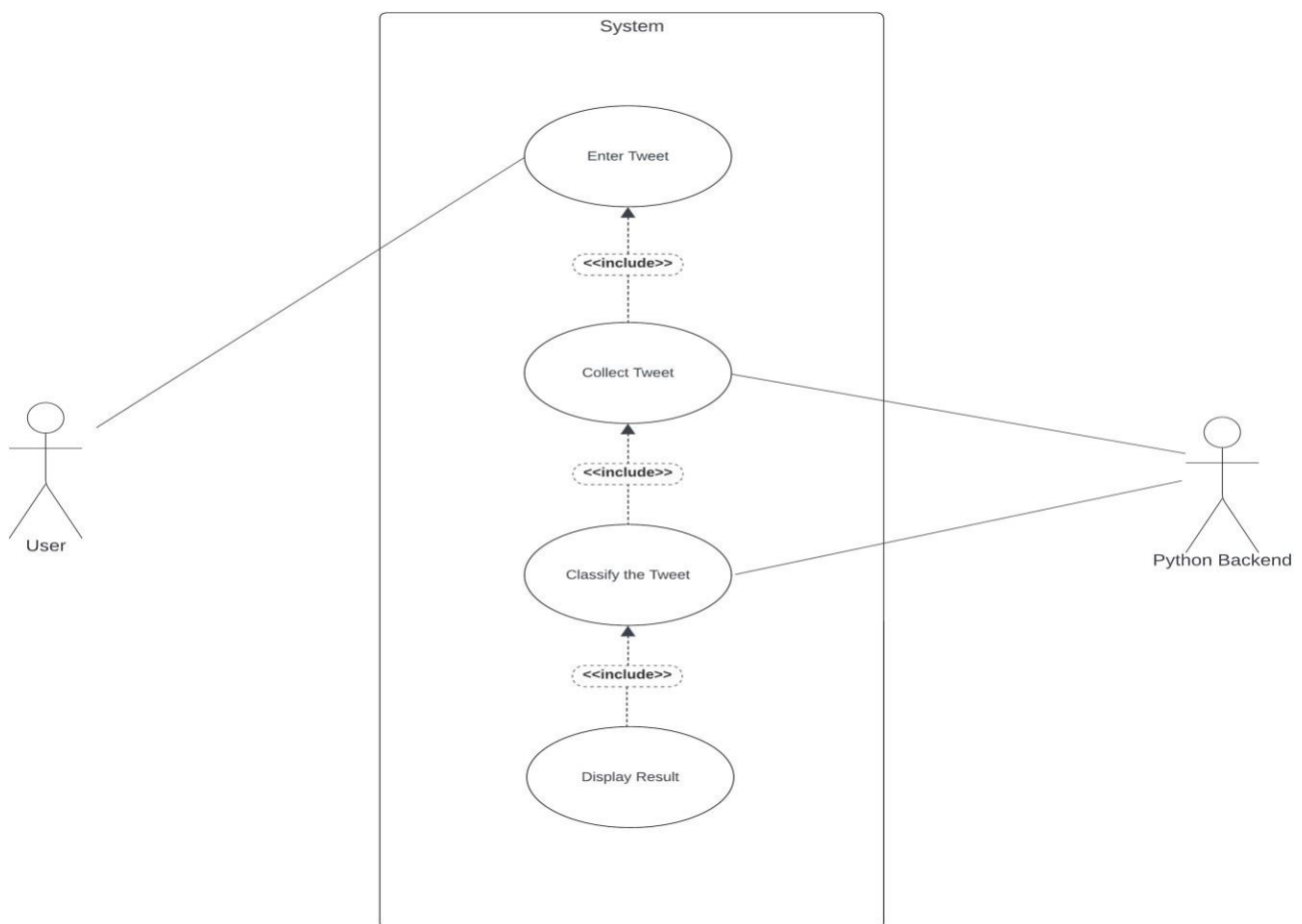


Figure 4.1 - Use Case Diagram

4.2.2 SEQUENCE DIAGRAM

Sequence diagrams describe interactions among classes in terms of an exchange of messages over time. They're also called event diagrams. A sequence diagram is a good way to visualize and validate various runtime scenarios. These can help to predict how a system will behave and to discover responsibilities a class may need to have in the process of modelling a new system.

The aim of a sequence diagram is to define event sequences, which would have a desired outcome. The focus is more on the order in which messages occur than on the message per se. However, the majority of sequence diagrams will communicate what messages are sent and the order in which they tend to occur. Basic Sequence Diagram Notations

Class Roles or Participants:

Class roles describe the way an object will behave in context. Use the UML object symbol to illustrate class roles, but don't list object attributes.

Activation or Execution Occurrence:

Activation boxes represent the time an object needs to complete a task. When an object is busy executing a process or waiting for a reply message, use a thin grey rectangle placed vertically on its lifeline.

Messages:

Messages are arrows that represent communication between objects. Use half-arrowed lines to represent asynchronous messages. Asynchronous messages are sent from an object that will not wait for a response from the receiver before continuing its tasks.

Lifelines:

Lifelines are vertical dashed lines that indicate the object's presence over time.

Destroying Objects:

Objects can be terminated early using an arrow labelled "<< destroy >>" that points to an X. This object is removed from memory. When that object's lifeline ends, you can place an X at the end of its lifeline to denote a destruction occurrence.

Loops:

A repetition or loop within a sequence diagram is depicted as a rectangle. Place the condition for exiting the loop at the bottom left corner in square brackets []. When modelling object interactions, there will be times when a condition must be met for a message to be sent to an object. Guards are conditions that need to be used throughout UML diagrams to control flow.

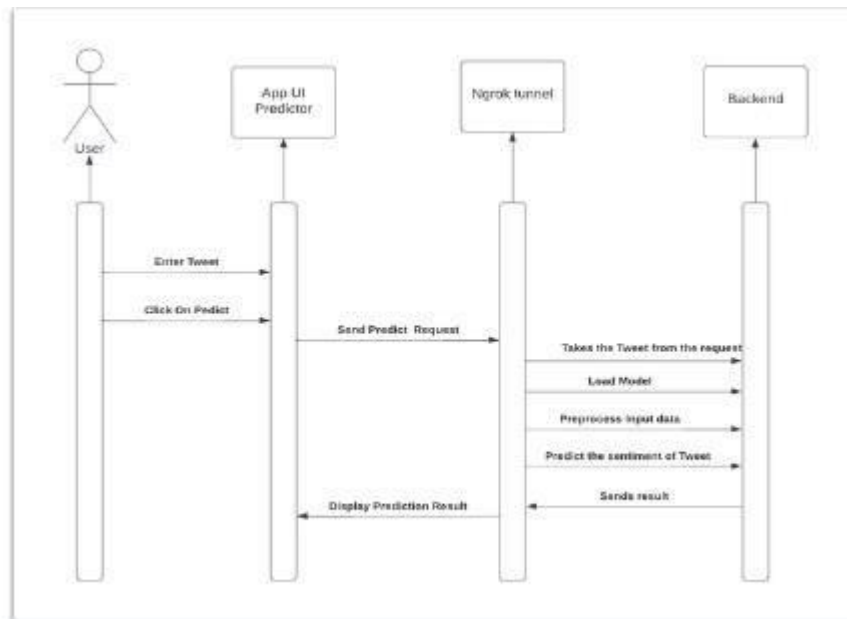


Figure 4.2 - Sequence Diagram

4.2.3 ACTIVITY DIAGRAM

Activity Diagrams describe how activities are coordinated to provide a service which can be at different levels of abstraction. Typically, an event needs to be achieved by some operations, particularly where the operation is intended to achieve a number of different things that require coordination, or how the events in a single use case relate to one another,

in particular, use cases where activities may overlap and require coordination. It is also suitable for modelling how a collection of use cases coordinates to represent business workflows.

- Identify candidate use cases, through the examination of business workflows
- Identify pre- and post-conditions (the context) for use cases
- Model workflows between/within use cases
- Model complex workflows in operations on objects
- Model in detail complex activities in a high-level activity Diagram

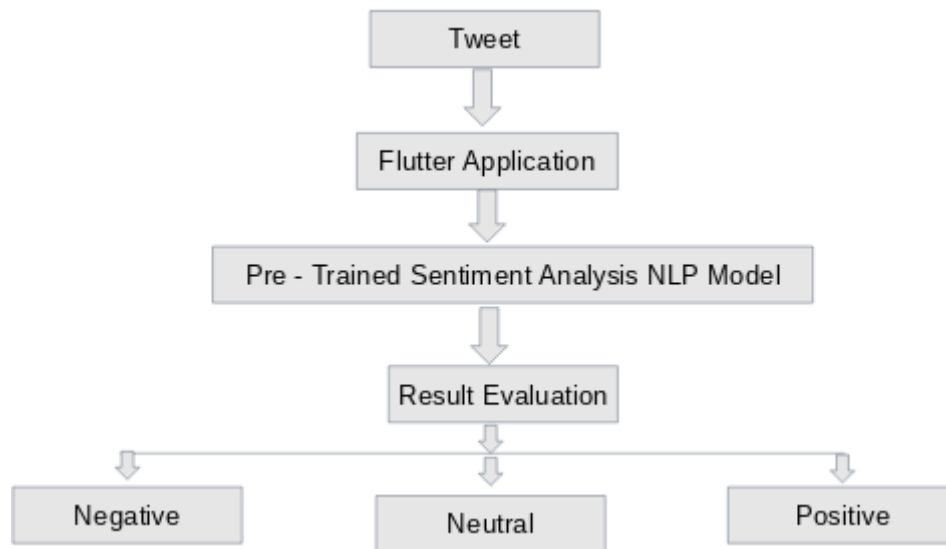


Figure 4.3 - Activity Diagram

4.2.4 CLASS DIAGRAM

Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application. Class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modeling of object-oriented systems because they are the only UML diagrams, which can be mapped directly with object-oriented languages. Class diagram shows a collection of classes, interfaces, associations, collaborations, and constraints. It is also known as a structural diagram.

Purpose of Class Diagrams:

The purpose of class diagram is to model the static view of an application. Class diagrams are the only diagrams which can be directly mapped with object-oriented languages and thus widely used at the time of construction.

UML diagrams like activity diagram, sequence diagram can only give the sequence flow of the application, however class diagram is a bit different. It is the most popular UML diagram in the coder community.

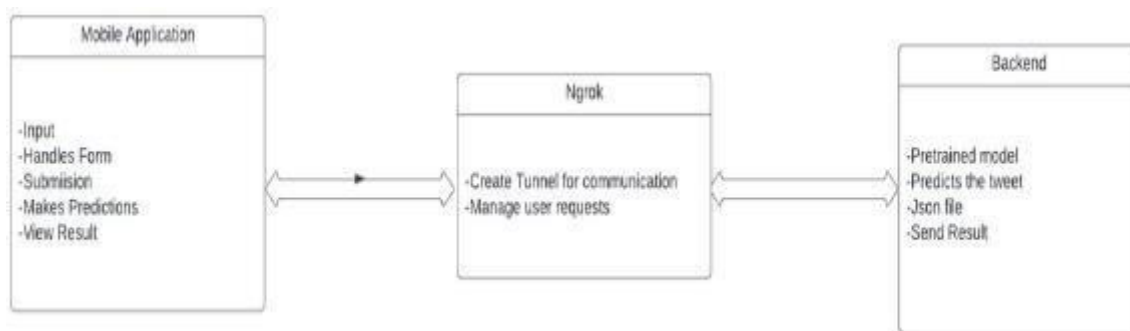


Figure 4.4 - Class Diagram

CHAPTER-5

5. IMPLEMENTATION

1.1 BACKEND – PYTHON

The backend is a Python script that creates a simple Flask web application for sentiment analysis of tweets using the Hugging Face Transformers library. The script defines a Flask route that takes a tweet as input, analyzes its sentiment, and returns the sentiment scores and the dominant sentiment label in JSON format.

```
from flask import Flask,request,jsonify
import subprocess
from transformers import AutoModelForSequenceClassification
from transformers import TFAutoModelForSequenceClassification
from transformers import AutoTokenizer, AutoConfig
import numpy as np
from scipy.special import softmax
```

Fig 5.1.1. Backend Imports

from flask import Flask, request, jsonify:

This line imports the Flask library, which is used to create a web application. It also imports request for handling incoming HTTP requests and jsonify for formatting JSON responses.

import subprocess:

This library allows you to run shell commands from Python.

from transformers import AutoModelForSequenceClassification:

This import statement is part of the Hugging Face Transformers library. It imports a pre-trained model for sequence classification tasks, which may be used for sentiment analysis.

from transformers import TFAutoModelForSequenceClassification:

Similar to the previous import, this line imports a TensorFlow-compatible version of the pre-trained model for sequence classification.

from transformers import AutoTokenizer, AutoConfig:

These imports are related to Hugging Face Transformers. AutoTokenizer is used for tokenizing text, and AutoConfig is used for configuring pre-trained models.

import numpy as np:

This line imports the numpy library as np. numpy is commonly used for numerical operations, and it may be used in the script for processing numerical data related to sentiment analysis.

from scipy.special import softmax:

This import statement specifically imports the softmax function from the scipy.special module. The softmax function is commonly used to compute the softmax activation on an array of scores, which is often used in classification tasks to convert raw scores into

probability distributions.

```
app = Flask(__name__)
@app.route("/", methods=['GET'])
def home():
    fquery=str(request.args['query'])
    Tweet = fquery.split("/")[-1]
    Tweet = Tweet[:-1]
    print(Tweet)
    MODEL = f"cardiffnlp/twitter-roberta-base-sentiment-latest"
    tokenizer = AutoTokenizer.from_pretrained(MODEL)
    config = AutoConfig.from_pretrained(MODEL)
    model = AutoModelForSequenceClassification.from_pretrained(MODEL)
    encoded_input = tokenizer(Tweet, return_tensors='pt')
    output = model(**encoded_input)
    scores = output[0][0].detach().numpy()
    scores = softmax(scores)
    print(scores)
    ranking = np.argsort(scores)
    ranking = ranking[::-1]
    st = ""
    c =config.id2label[ranking[0]]
    for i in range(scores.shape[0]):
        l = config.id2label[ranking[i]]
        s = scores[ranking[i]]
        st = st + f"{i+1}. {l} {np.round(float(s), 4)}\n"

    print(st)
    print(c)
    dic={}
    dic['output'] = st
    dic['color'] = c
    return jsonify(dic)
if __name__ == "__main__":
    app.run()
```

Fig 5.1.2. Api

1. Flask App Initialization:

The app variable is initialized as a Flask application using Flask(__name__). This line creates an instance of the Flask web framework, which serves as the main entry point for defining the behavior of the web service. The __name__ argument is used to determine the root path for the application.

2. Route Definition:

The @app.route("/") decorator defines a route for handling HTTP GET requests at the root URL ("/"). In Flask, routes are used to map URLs to specific functions (view functions). In this case, the root URL is the main route for the web service, and it's associated with the home function.

3. Request Handling:

The home function is defined to handle GET requests to the root URL. Within this function:

The `request.args['query']` extracts the value of the "query" parameter from the request's query string. This parameter is expected to contain the text that needs to be analyzed for sentiment.

The provided text (retrieved from the URL) is processed to isolate the Tweet by splitting the URL path and removing the trailing slash.

4. Model Loading and Sentiment Analysis:

The code loads a pre-trained sentiment analysis model using the Hugging Face Transformers library. The specific model used is "cardiffnlp/twitter-roberta-base-sentiment-latest." The code also loads the model's tokenizer and configuration.

The input Tweet is tokenized and prepared in a format suitable for the model. The sentiment analysis model processes this input, generating sentiment scores.

The sentiment scores are normalized using the softmax function to produce a probability distribution over sentiment classes, ensuring that the scores sum up to 1.

5. Sentiment Classification:

The sentiment classes are ranked based on their scores using the `np.argsort` function. The ranking is then reversed (using `ranking[::-1]`) to place the most likely sentiment category at the front of the ranking.

6. JSON Response:

The results, including the sentiment scores and the ranking of classes, are formatted into a Python dictionary with two keys:

output: Contains a formatted string representation of the sentiment classes, their scores, and rankings.

color: Contains the most likely sentiment category.

7. Response:

The `jsonify` function is used to convert the Python dictionary into a JSON response. This JSON response is sent back to the client as the web service's response.

8. Main Block:

The script checks whether it's the main module by using `if __name__ == "__main__"`. If it is, it starts the Flask web service using `app.run()`. This line of code tells Flask to listen for incoming HTTP requests and handle them according to the route definitions and functions specified.

Execution:

1. Install all the required installations.
2. Open the terminal and run the `api.py` file using the command "python api.py".
3. Copy the localhost link(<http://127.0.0.1:5000>).

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS C:\Twitter-Analysis\Backend> python api.py
* Serving Flask app 'api'
* Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on http://127.0.0.1:5000
Press CTRL+C to quit
```

Fig 5.1.3. Api output

1.2 NGROK

Ngrok is an essential component in your Android app, enabling a secure tunnel between the mobile application and the machine learning backend. This secure connection safeguards data during transmission, bypasses complex networking configurations, and provides real-time monitoring. It ensures a seamless and protected exchange of information.

```
NAME:
  ngrok - tunnel local ports to public URLs and inspect traffic

USAGE:
  ngrok [command] [flags]

DESCRIPTION:
  ngrok exposes local networked services behinds NATs and firewalls to the
  public internet over a secure tunnel. Share local websites, build/test
  webhook consumers and self-host personal services.
  Detailed help for each command is available with 'ngrok help <command>'.
  Open http://localhost:4040 for ngrok's web interface to inspect traffic.

Author:
  ngrok - <support@ngrok.com>

TERMS OF SERVICE: https://ngrok.com/tos

EXAMPLES:
  ngrok http 80                                # secure public URL for port 80 web server
  ngrok http --domain baz.ngrok.dev 8080        # port 8080 available at baz.ngrok.dev
  ngrok http foo.dev:80                        # tunnel to host:port instead of localhost
  ngrok http https://localhost                 # expose a local https server
  ngrok tcp 22                                 # tunnel arbitrary TCP traffic to port 22
  ngrok tls --domain=foo.com 443               # TLS traffic for foo.com to port 443
  ngrok start foo bar baz                     # start tunnels from the configuration file
```

Fig 5.2.1. Ngrok

```

COMMANDS:
  api                use ngrok agent as an api client
  completion         generates shell completion code for bash or zsh
  config             update or migrate ngrok's configuration file
  credits            prints author and licensing information
  diagnose           diagnose connection issues
  help               Help about any command
  http              start an HTTP tunnel
  service            run and control an ngrok service on a target operating system
  start              start tunnels by name from the configuration file
  tcp                start a TCP tunnel
  tls                start a TLS tunnel
  tunnel             start a tunnel for use with a tunnel-group backend
  update             update ngrok to the latest version
  version            print the version string

OPTIONS:
  --config strings  path to config files; they are merged if multiple
  -h, --help        help for ngrok
  -v, --version      version for ngrok

ngrok is a command line application, try typing 'ngrok.exe http 80'
at this terminal prompt to expose port 80.

```

Fig 5.2.2. Ngrok Introduction

Execution:

1. Open the ngrok.
2. Enter the command “ngrok http <http://127.0.0.1:5000>”.
- 3.

```
C:\Users\vikas\OneDrive\Desktop>ngrok http http://127.0.0.1:5000
```

Fig 5.2.3. Ngrok command

4. The local tunnel creates on the local host. Copy the Web Interface link and paste in the flutter application and run the application.

```

ngrok (Ctrl+C to quit)

Introducing Always-On Global Server Load Balancer: https://ngrok.com/x/gslb

Session Status      online
Account             vikasreddy2309@gmail.com (Plan: Free)
Update              update available (version 3.3.5, Ctrl-U to update)
Version             3.3.0
Region              India (in)
Latency             -
Web Interface        http://127.0.0.1:4040
Forwarding           https://8e4d-2405-201-c00e-60b7-58b4-6dbe-3082-a2b0.ngrok-free.app -> http://127.0.0.1:5000

Connections
  ttl    opn    rt1    rt5    p50    p90
   0      0     0.00   0.00   0.00   0.00

```

Fig 5.2.4. Ngrok Output

1.3 FRONTEND – FLUTTER APPLICATION

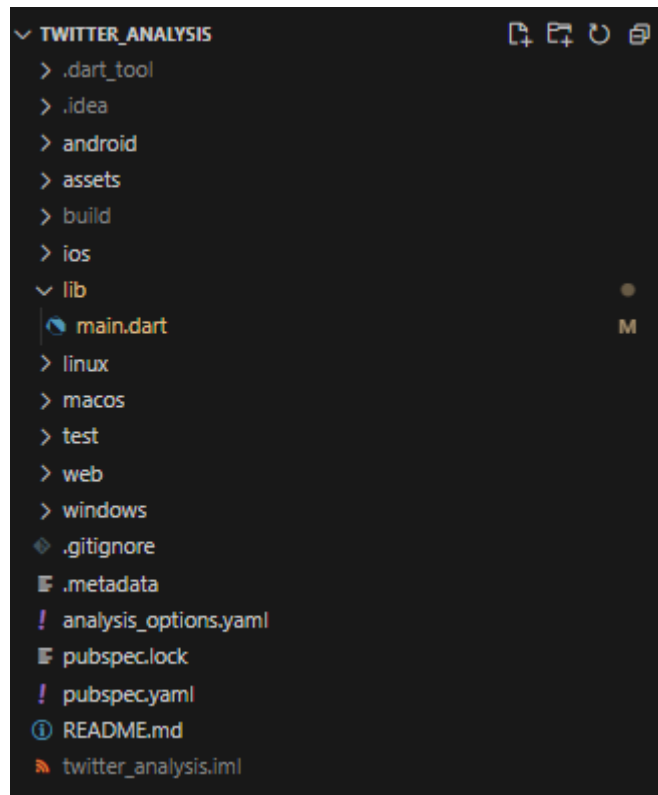


Fig 5.3.1. Index

The front-end of the Android app is constructed using the Flutter framework. Known for its versatility and ability to create visually appealing, responsive, and cross-platform applications, Flutter was an ideal choice for this project.

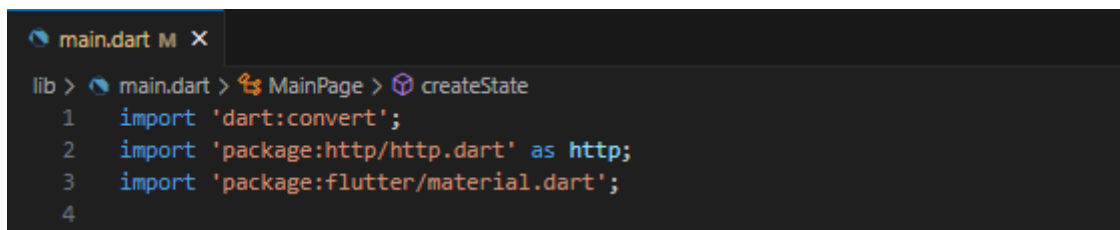


Fig 5.3.2. Flutter Imports

import 'dart:convert':

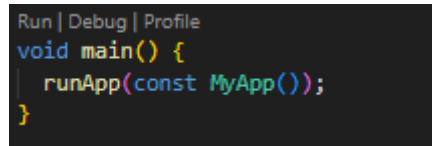
This line imports the convert library from the Dart standard library. The convert library provides functionality for encoding and decoding data, including JSON encoding and decoding.

import 'package:http/http.dart' as http:

This line imports the http package from the Flutter ecosystem and gives it an alias name http. This package provides classes and functions to make HTTP requests, which are commonly used in mobile and web applications to fetch data from remote servers.

import 'package:flutter/material.dart':

This line imports the material.dart library from the Flutter framework. Flutter is an open-source framework for building natively compiled applications for mobile, web, and desktop from a single codebase. The material.dart library provides widgets and components for building user interfaces with the Material Design style.

A screenshot of a code editor with a dark background. At the top, there are three tabs labeled 'Run', 'Debug', and 'Profile'. Below the tabs, the code for the main function is displayed in a light blue font. The code is:

```
void main() {  
  runApp(const MyApp());  
}
```

Fig 5.3.3. main

The code above is a Dart function main() that serves as the entry point for a Flutter application.

void main():

This line defines the main function, which is the starting point of a Dart application. In a Flutter application, the main function is where the execution begins.

runApp(const MyApp()):

This line calls the runApp function, which is a part of the Flutter framework. The runApp function is responsible for starting the Flutter application and rendering its user interface.

const MyApp() creates an instance of the MyApp widget. In Flutter, the user interface of an application is built using widgets. MyApp is typically the root widget of a Flutter application and is responsible for configuring and structuring the entire application.

The const keyword is used to create a constant instance of the MyApp widget, which can help improve performance by reducing widget rebuilds if the widget's properties don't change.

```

class MyApp extends StatelessWidget {
  static const String title = 'Tweet Analyzer';

  // Define a custom MaterialColor
  static const MaterialColor customBlack = MaterialColor(
    0xFF000000, // This is the primary value, which is black in this case
    <int, Color>{
      50: Color(0xFFEDED), // You can define shades of black if needed
      100: Color(0xFFD1D1),
      200: Color(0xFFB6B6),
      300: Color(0xFF9A9A),
      400: Color(0xFF8080),
      500: Color(0xFF0000), // Primary color (black)
      600: Color(0xFF0000),
      700: Color(0xFF0000),
      800: Color(0xFF0000),
      900: Color(0xFF0000),
    },
  ); // MaterialColor

  const MyApp({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) => MaterialApp(
    debugShowCheckedModeBanner: false,
    title: title,
    theme: ThemeData(
      primarySwatch: customBlack, // Use the customBlack MaterialColor
      scaffoldBackgroundColor: Colors.white, // Set background color
    ), // ThemeData
    home: const MainPage(),
  ); // MaterialApp
}

```

Fig 5.3.4. MyApp class

The code is a Dart class named `MyApp` that extends `StatelessWidget`. In a Flutter application, this class is typically the starting point for configuring the overall theme and structure of the app.

`static const String title = 'Tweet Analyzer':`

This line defines a constant string variable named `title` with the value "Tweet Analyzer." This variable represents the title of the Flutter application.

`static const MaterialColor customBlack = MaterialColor(...):`

This section defines a custom `MaterialColor` named `customBlack`. `MaterialColors` are used to define a palette of colors in Flutter, typically for the app's primary and secondary colors. In this case, it defines various shades of black. The primary value is set to black (0xFF000000), and shades of black are defined with different opacity levels from 50 to 900.

`const MyApp({Key? key}) : super(key: key):`

This is the constructor for the `MyApp` class. It takes an optional `Key` as a parameter, which is commonly used for identifying widgets. The constructor calls the constructor of the `StatelessWidget` superclass, passing the optional key parameter.

`@override:`

This annotation indicates that the following method overrides a method from the superclass.

`Widget build(BuildContext context) => MaterialApp(...):`

This method overrides the `build` method from the `StatelessWidget` class and returns a

MaterialApp widget. The MaterialApp widget is the root widget of the Flutter application.

debugShowCheckedModeBanner: false disables the debug banner in the top-right corner of the app when in debug mode.

title:

Title sets the title of the application to the previously defined title constant.

theme:

ThemeData(...) defines the theme for the application. It specifies the primary color swatch as the customBlack MaterialColor and sets the background color to white.

home:

const MainPage() sets the initial route for the application to an instance of the MainPage widget.

```
class MainPage extends StatefulWidget {  
  const MainPage({Key? key}) : super(key: key);  
  
  @override  
  // ignore: library_private_types_in_public_api  
  _MainPageState createState() => _MainPageState();  
}
```

Fig 5.3.5. MainPage class

The code defines a Dart class named MainPage, which extends StatefulWidget. In a Flutter

application, StatefulWidget is used for widgets that can change or have mutable state.

const MainPage({Key? key}) : super(key: key):

This is the constructor for the MainPage class. It takes an optional Key as a parameter, which can be used to identify the widget uniquely. The constructor calls the constructor of the StatefulWidget superclass, passing the optional key parameter.

@override

This annotation indicates that the following method overrides a method from the superclass.

MainPageState createState() => _MainPageState():

This method overrides the createState method of the StatefulWidget class and returns an

instance of _MainPageState. The _MainPageState class is typically a separate class defined within the same file, and it is responsible for managing the mutable state of the MainPage widget.


```

class _MainPageState extends State<MainPage> {
  TextEditingController inputController = TextEditingController();
  // ignore: non_constant_identifier_names
  String RESULT = "";
  String resultColor = ""; // Store the color value

  bool isLoading = false;

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: const Text(MyApp.title),
        centerTitle: true,
      ), // AppBar
      body: Container(
        padding: const EdgeInsets.all(32),
        child: Center(
          child: Column(
            mainAxisAlignment: MainAxisAlignment.center,
            children: [
              TextFormField(
                controller: inputController,
                decoration: const InputDecoration(
                  labelText: 'Enter Tweet',
                  border: OutlineInputBorder(),
                  fillColor: Colors.white,
                  filled: true,
                ), // InputDecoration
                maxLines: 5,
                style: const TextStyle(color: Colors.black),
              ), // TextFormField
              const SizedBox(height: 20),
            ],
          ),
        ),
      ),
    );
  }
}

```

Fig 5.3.6. MainPageState class

The code defines the `_MainPageState` class, which is a state class for a Flutter widget called `MainPage`. This class manages the state and the user interface of the `MainPage` widget.

`TextEditingController inputController = TextEditingController();`

This line creates a `TextEditingController` named `inputController`. It is used to control and manage the text input field, allowing you to read the user's input and modify the input programmatically.

`String RESULT = "";`

This line defines a `String` variable named `RESULT` and initializes it to an empty string. This variable will be used to store the result of some operation or text that needs to be displayed on the screen.

`String resultColor = "";`

This line defines a `String` variable named `resultColor` to store color information. It is used to determine the color of some UI elements based on the result.

bool isLoading = false:

This is a boolean variable named `isLoading` initialized to `false`. It is used to track whether a time-consuming operation is in progress, such as data processing. It's used to disable the button and show a loading indicator during processing.

The build method:

The `build` method is overridden to define the user interface for the `MainPage` widget.

It creates a `Scaffold` widget, which provides a basic app structure with an app bar and a body.

The `AppBar` contains a title with the text "Tweet Analyzer," which is obtained from the `MyApp.title` constant.

The body is a `Container` widget with padding, and it contains a `Column` widget. The `Column` widget contains several UI elements vertically stacked.

Inside the `Column` widget, there's a `TextFormField` widget that provides a text input field for the user to enter a tweet.

```
FocusScope(
  child: ElevatedButton(
    onPressed: isLoading
      ? null
      : () {
          predict();
          FocusScope.of(context).unfocus();
        },
    // ignore: sort_child_properties_last
    child: Text(isLoading ? 'Processing...' : 'Predict'),
    style: ElevatedButton.styleFrom(
      backgroundColor: const Color.fromARGB(255, 9, 20, 9),
      textStyle: const TextStyle(
        fontSize: 18,
        fontWeight: FontWeight.bold,
      ), // TextStyle
    ), // ElevatedButton
  ), // FocusScope
  const SizedBox(height: 20),
  if (isLoading)
    const CircularProgressIndicator()
  else if (RESULT.isNotEmpty)
    ResultDisplay(RESULT, resultColor), // Pass the color value
), // Column
), // Center
), // Container
); // Scaffold
}
```

Fig 5.3.7. Elevated Button

Below the text input, there's an `ElevatedButton` widget. It is either enabled or disabled based on the `isLoading` variable. If it's disabled, the button shows "Processing..." as the label; otherwise, it shows "Predict." The button's background color and other styles are defined using `ElevatedButton.styleFrom`.

If `isLoading` is true, a `CircularProgressIndicator` is shown to indicate that a process is in progress.

If RESULT is not empty, a custom ResultDisplay widget is shown. The ResultDisplay widget is responsible for displaying the result and using the resultColor to determine its color.

```
Future<void> predict() async {
  final inputText = inputController.text;
  if (inputText.isEmpty) {
    return;
  }
  setState(() {
    isLoading = true;
    RESULT = "";
  });

  try {
    final response = await http.get(Uri.parse(
      "https://eaa7-157-47-31-34.ngrok-free.appR/?query=$inputText"));

    if (response.statusCode == 200) {
      final decoded = jsonDecode(response.body);
      setState(() {
        RESULT = decoded["output"];
        resultColor = decoded["color"]; // Store the color value
      });
    } else {
      setState(() {
        RESULT = "Error occurred.";
      });
    }
  } catch (e) {
    setState(() {
      RESULT = "Error occurred: $e";
    });
  } finally {
    setState(() {
      isLoading = false;
    });
  }
}
```

Fig 5.3.8. Predict Function

The code defines a predict function within the `_MainPageState` class. This function is responsible for making an HTTP GET request to a remote server, processing the response, and updating the state of the MainPage widget based on the result.

Future<void> predict() async:

This line defines the predict function, which is asynchronous (marked with the `async` keyword) because it involves network communication that may take time to complete.

final inputText = inputController.text:

This line retrieves the text entered by the user in the text input field and stores it in the `inputText` variable.

if (inputText.isEmpty) { return; }:

This condition checks if the user input is empty. If it is, the function returns early, and no

further processing is done.

setState() { isLoading = true; RESULT = ''; }):

Inside a setState callback, this code updates the state of the MainPage widget. It sets isLoading to true and clears the RESULT by setting it to an empty string. This change in state

triggers a rebuild of the widget, reflecting these changes in the UI.

The try block:

Within this block, an HTTP GET request is made using the http.get method to a specific URL. It sends the user's input text as a query parameter.

If the response status code is 200 (indicating a successful response), the code parses the response body as JSON using jsonDecode. It then updates the RESULT and resultColor variables based on the decoded JSON.

If the response status code is not 200, it sets the RESULT to "Error occurred."

If an exception is caught during the HTTP request or response processing, it sets the RESULT to "Error occurred" along with the error message.

The finally block:

Regardless of whether the request was successful or resulted in an error, the isLoading variable is set to false in the finally block. This is done to ensure that the loading indicator is turned off when the request is completed.

```

class ResultDisplay extends StatelessWidget {
  final String resultText;
  final String resultColor;

  const ResultDisplay(this.resultText, this.resultColor, {Key? key})
    : super(key: key);

  Color getCardColor(String color) {
    if (color == "neutral") {
      return Colors.blue;
    } else if (color == "positive") {
      return Colors.green;
    } else {
      return Colors.red;
    }
  }
}

```

Fig 5.3.9. Result Display

The code defines a Dart class named ResultDisplay, which is a StatelessWidget used to display the result of some operation.

final String resultText:

This is a final string variable named resultText that stores the text to be displayed as the result.

final String resultColor;

This is a final string variable named resultColor that stores a string representing the color of the result.

const ResultDisplay(this.resultText, this.resultColor, {Key? key}) : super(key: key):

This is the constructor for the ResultDisplay class. It takes the resultText and resultColor as parameters, allowing you to pass the result text and its associated color when creating an instance of this widget. The constructor calls the constructor of the StatelessWidget

superclass, passing the optional key parameter.

Color getCardColor(String color) { ... }

This is a method named getCardColor that takes a color parameter (a string) and returns a Color object. It is used to determine the background color of a card (or container) based on the provided color string.

If the color is "neutral," it returns Colors.blue.

If the color is "positive," it returns Colors.green.

For any other value of color, it returns Colors.red.

This ResultDisplay widget is designed to display the result text with a background color that represents the sentiment or category associated with the result. The resultColor parameter is used to determine the background color, and the resultText parameter is used

to display the result text.

```
@override
Widget build(BuildContext context) {
  if (resultColor == "neutral") {
    // Change text color to black for neutral
  } else if (resultColor == "positive") {
  } else {}

  return Card(
    elevation: 4,
    color: getCardColor(resultColor), // Set card color
    child: Padding(
      padding: const EdgeInsets.all(16),
      child: Text(
        resultText,
        style: const TextStyle(
          fontSize: 20,
          fontWeight: FontWeight.w500,
          color: Colors.white,
        ), // TextStyle
      ), // Text
    ), // Padding
  ); // Card
}
```

Fig 5.3.10. Result Display Build Method

The code is the build method of the ResultDisplay widget, and it defines how the result is displayed within a card.

@override:

This annotation indicates that the following method overrides a method from the superclass.

Widget build(BuildContext context):

This is the build method, which is responsible for defining the user interface of the ResultDisplay widget.

The conditional statements:

There are conditional statements that check the resultColor to determine the text color of the result. However, the code inside these conditions is missing. Typically, you would set the text color for "neutral" and "positive" cases inside these conditions. If needed, you can use the TextStyle to specify the color.

return Card(...):

This code returns a Card widget as the root of the widget hierarchy for this ResultDisplay. The Card is used to create a card-like container for displaying the result.

elevation:

This sets the elevation of the card, giving it a shadow effect.

color: getCardColor(resultColor):

This sets the background color of the card using the getCardColor method. The resultColor is used to determine the background color based on the sentiment or category of the result.

child: Padding(...):

The child property of the Card is a Padding widget that wraps a Text widget. It adds padding around the text to control spacing.

Text(...):

Inside the Padding widget, there's a Text widget that displays the resultText. It uses a TextStyle to define the text's appearance, including font size, weight, and color. In this case, it sets the font size to 20, the font weight to "w500," and the text color to white.

The build method constructs a card containing the result text with a specific background color based on the resultColor. You can further customize the text color for "neutral" and "positive" cases as needed within the conditional statements, which are currently empty. Additionally, you can set the text color by modifying the TextStyle properties.

Execution:

1. Connect mobile device through usb with enabling the “Developer options”.
2. Check device is connected to system.
3. Open main.dart in editor to edit the code.
4. Open terminal and execute the code “flutter run”.
5. The application open in the connected device.

1.4 Technical Challenges and Solutions

1. Handling Multi Users:

- Challenge: Handling different multi users at a time.
- Solution: You overcame this challenge by deploying in the server.

2. GitHub Merge Conflicts:

- Challenge: Collaborating with team members on the project led to multiple instances of GitHub merge conflicts during pull requests. These conflicts needed to be resolved to maintain code integrity.
- Solution: Your team addressed this challenge by closely coordinating and discussing the merge conflicts. You successfully sorted out the issues by carefully reviewing and integrating the changes, which ultimately allowed you to create successful pull requests and maintain code consistency.

3. Creating tunnel using the ngrok:

- Challenge: Creating tunnel between frontend and backend to fcommunicate.
- Solution: Ngrok is used to create tunnel by pasting the command in flutter application.

CHAPTER-6

6. TESTING

Software Testing is evaluation of the software against requirements gathered from users and system specifications. Testing is conducted at the phase level in software development life cycle or at module level in program code. Software testing comprises of Validation and Verification

1. SOFTWARE VALIDATION

Validation is process of examining whether or not the software satisfies the user requirements. It is carried out at the end of the SDLC. If the software matches requirements for which it was made, it is validated.

Validation ensures the product under development is as per the user requirements.

Validation emphasizes on user requirements.

2. SOFTWARE VERIFICATION

Verification is the process of confirming if the software is meeting the business requirements and is developed adhering to the proper specifications and methodologies. Verification ensures the product being developed is according to design specifications. Verification answers the question– "Are we developing this product by firmly following Verifications concentrate on the design and system specifications.

3. TARGET OF THE TEST ARE

- Errors -These are actual coding mistakes made by developers. In addition, there is a difference in output of software and desired output, considered as an error.
- Fault - When error exists fault occurs. A fault, also known as a bug, is a result of an error which can cause system to fail.
- Failure - failure is said to be the inability of the system to perform the desired task. Failure occurs when fault exists in the system.

4. BLACK-BOX TESTING

It is carried out to test functionality of the program. It is also called 'Behavioral' testing. The tester in this case, has a set of input values and respective desired results. On providing input, if the output matches with the desired results, the program is tested 'ok', and problematic otherwise.

Black-Box Testing Techniques

- Equivalence class - The input is divided into similar classes. If one element of a class passes the test, it is assumed that all the class is passed.

- Boundary values - The input is divided into higher and lower end values. If these values pass the test, it is assumed that all values in between may pass too.
- Cause-effect graphing - In both previous methods, only one input value at a time is tested. Cause (input) – Effect (output) is a testing technique where combinations of input values are tested in a systematic way.
- Pair-wise Testing - The behavior of software depends on multiple parameters. In pair wise testing, the multiple parameters are tested pair-wise for their different values.
- State-based testing - The system changes state on provision of input. These systems are tested based on their states and input.

WHITE-BOX TESTING

It is conducted to test program and its implementation, in order to improve code efficiency or structure. It is also known as ‘Structural’ testing

In this testing method, the design and structure of the code are known to the tester.

The following are some White box testing techniques

- Control-flow testing - The purpose of the control-flow testing to set up a test case which covers all statements and branch conditions. The branch conditions are tested for both being true and false, so that all statements can be covered.
- Data-flow testing - This testing technique emphasis to cover all the data variables included in the program. It tests where the variables were declared and defined and where they were used or changed.

TESTING LEVELS

Testing itself may be defined at various levels of SDLC. The testing process runs parallel to software development. Before jumping on the next stage, a stage is tested, validated and verified. Testing separately is done just to make sure that there are no hidden bugs or issues left in the software.

Unit Testing

While coding, the programmer performs some tests on that unit of program to know if it is error free. Testing is performed under white-box testing approach. Unit testing helps developers decide that individual units of the program are working as per requirement and are error free. Unit testing helps developers decide that individual units of the program are working as per requirement and are error free.

UNIT	PURPOSE	STATUS
Flutter app	when user enter the tweet and press submit button, ngrok establish tunnel is established correctly and api accepts and sends the response.	Success
Flutter app	when user enter the tweet and press submit button, Then app shows the error.	Fail
Api	when user enter the tweet and press submit button, ngrok establish tunnel is established correctly and api doesn't accept the incoming requests.	Fail
Ngrok	when the ngrok tunnel link expires that means there is no bridge between application and API	Fail
Api	when the user enters the tweet and press submit button, ngrok establish tunnel is established correctly and api accepts and fails to send response.	Partial Success/Partial Fail
Flutter app	when the user enters the tweet and submit button, Time out error for response.	Partial Success/Partial Fail
Ngrok	Ngrok link expires after accepting the request that means it fails to send response.	Partial Success/Partial Fail

Table 6.1 : Summary of Unit tests

Integration Testing

Even if the units of software are working fine individually, there is a need to find out if the units if integrated together would also work without errors. For example, argument passes and data updating etc.

System Testing

The software is compiled as product and then it is tested as a whole. This can be accomplished using one or more of the following tests:

- Functionality testing - Tests all functionalities of the software against requirement.
- Performance testing - This test proves how efficient the software is. It tests the

effectiveness and average time taken by the software to do desired task. Performance testing is done by means of load testing and stress testing where the software is put under high user and data load under various environment conditions.

- Security & Portability - These tests are done when the software is meant to work on various platforms and accessed by number of persons.

Acceptance Testing

When the software is ready to hand over to the customer it has to go through last phase of testing where it is tested for user-interaction and response. This is important because even if the software matches all user requirements and if user does not like the way it or works, it may be rejected.

- Alpha testing - The team of developer themselves perform alpha testing by using the system as if it is being used in work environment. They try to find out how user would react to some action in software and how the system should respond to inputs.
- Beta testing - After the software is tested internally, it is handed over to the users to use it under their production environment only for testing purpose. This is not as yet the delivered product. Developers expect that users at this stage will bring minute 65 problems, which were skipped to attend.

Regression Testing

Whenever a software product is updated with new code, feature or functionality, it is tested thoroughly to detect if there is any negative impact of the added code.

End-to-End Testing

End-to-End testing is a type of Software testing that not only validates the software system under test but also check its integration with external interfaces. It uses actual production like data and test environment to simulate real-time settings. End-to-End testing is also called Chain testing. End-to-End design framework consists of three parts: Build User functions, Build conditions, Build test cases.

CHAPTER-7

7. SCREENSHOTS

7.1 Approach description

The approach used to build the Sentiment Analysis App, which leverages Flutter, pre-loaded models, and an Ngrok tunnel, initiates with meticulous planning. The project begins by identifying the need for such an app, considering the challenges users face in understanding and analyzing sentiment in textual data. The concept is developed, and a comprehensive project plan is formulated, outlining objectives, the intended user base, and the choice of technology stack.

In the case of this app, the technology stack predominantly revolves around Flutter, which provides a versatile and efficient framework for cross-platform app development. Pre-loaded sentiment analysis models are integrated into the app, enhancing its functionality and ensuring users can perform sentiment analysis seamlessly. Ngrok is used to create a secure tunnel, enabling secure connections for data transmission between the app and the sentiment analysis service.

Once the planning phase is complete, the design and user experience considerations come into focus. Designers work meticulously to craft an intuitive and aesthetically pleasing user interface. Wireframes or mockups are created to visualize the app's layout and features. Attention is given to the user journey, ensuring that users can easily input text for sentiment analysis and receive clear and interpretable results.

The development process comprises two primary components: the app's front end and the integration of the pre-loaded sentiment analysis model. In Flutter, the front end is developed, featuring user-friendly interfaces for text input, analysis request, and result display. The pre-loaded sentiment analysis model is seamlessly integrated into the app's core functionality.

Key functionalities are embedded within the app, including user authentication, text input, and sentiment analysis processing. Users can securely log in, input text for analysis, and receive sentiment scores. The Ngrok tunnel facilitates secure communication between the app and the sentiment analysis model.

After the app's launch, user feedback is actively sought and incorporated into further updates and enhancements. As the user base grows, the app is scaled and maintained to optimize performance and ensure data security. Regular updates, bug fixes, and dependency management are essential for ongoing maintenance.

A marketing strategy is developed to attract users to the app, utilizing various channels like social media, content marketing, and partnerships with relevant organizations. The aim is to build a vibrant community around the app, encouraging users to share their experiences and success stories while maintaining an engaging and supportive environment for sentiment analysis. This approach combines technological development, user-centric design, and community engagement to create a valuable and effective Sentiment Analysis App.

7.2 PESENTATION OF RESULTS

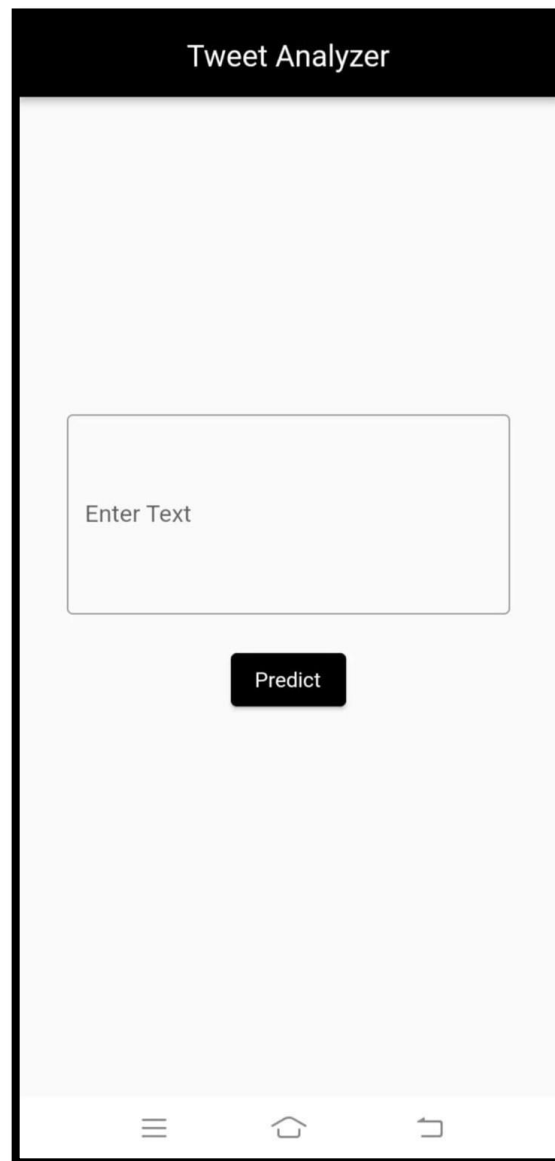


Fig 7.2.1 Application Frontend

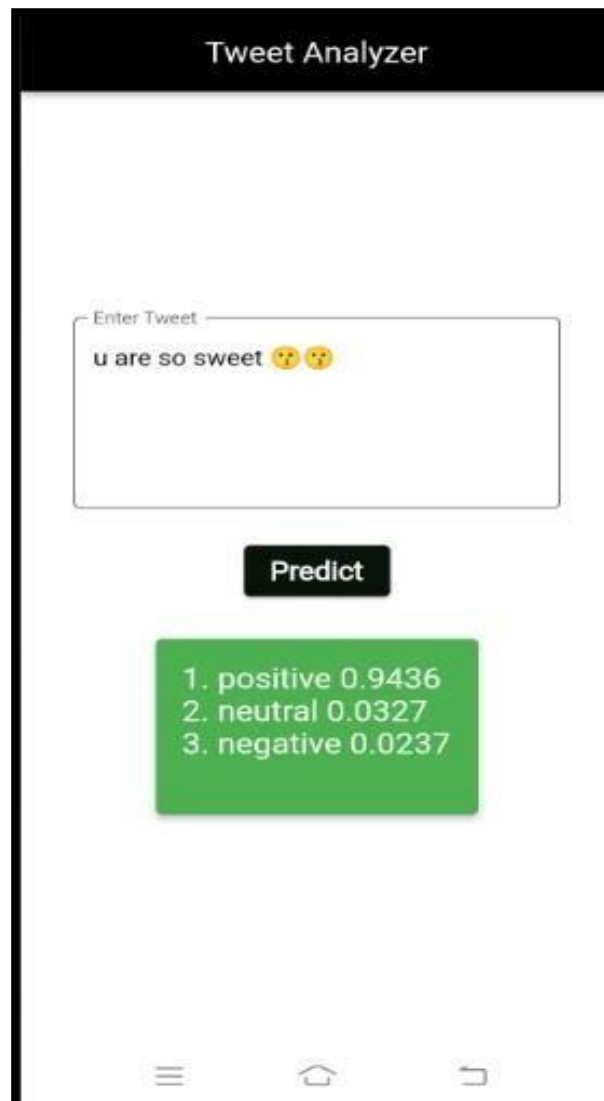


Fig 7.2.2 Positive Case

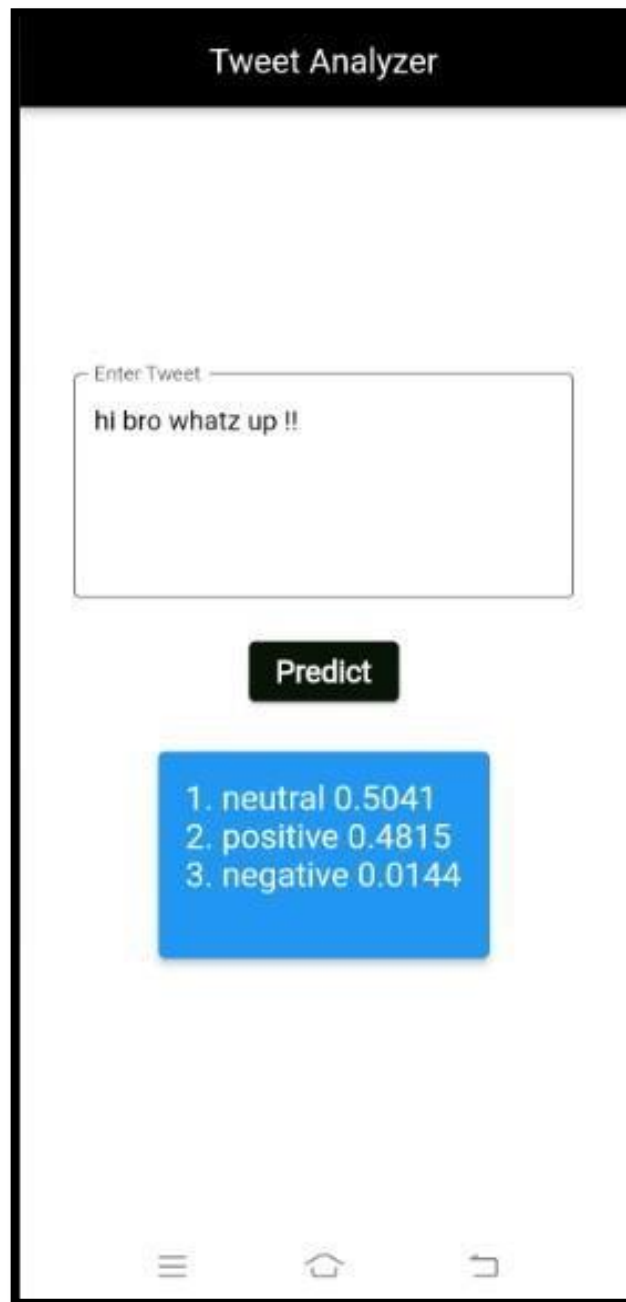


Fig 7.2.3 Neutral Case

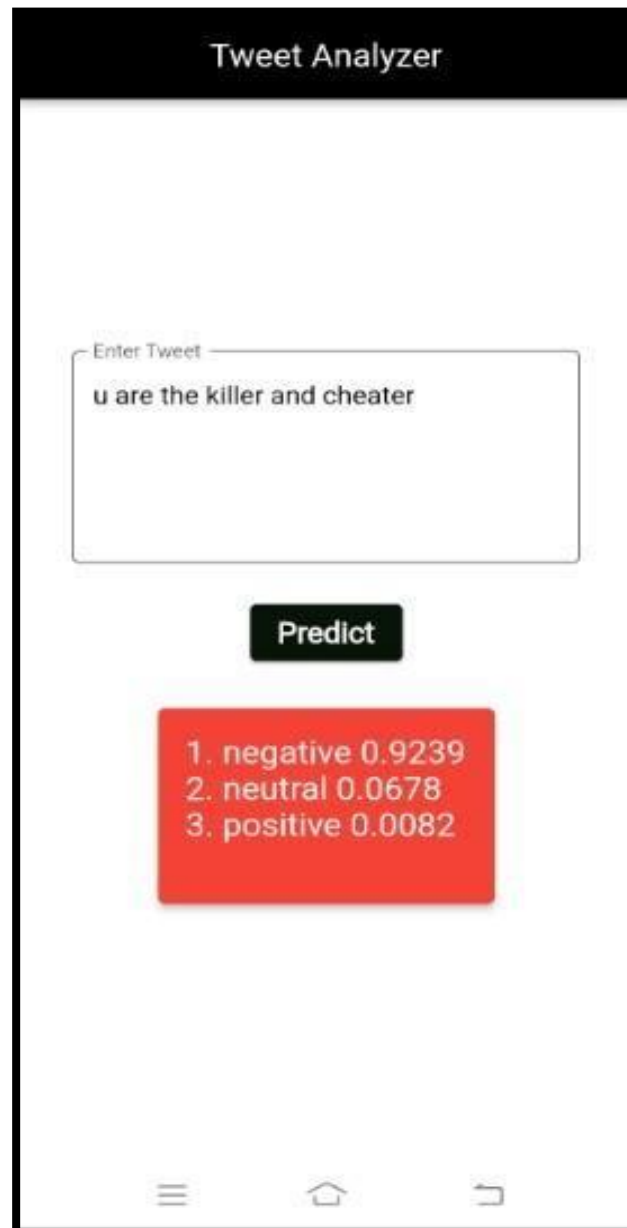


Fig 7.2.4 Negative Case

CHAPTER-8

8. FUTURE SCOPE

The future scope of the "Twitter Analysis Mobile Application" project is vast and holds the potential for further development and expansion in several key areas. As the digital landscape and the use of social media continue to evolve, the project can adapt and grow to meet emerging needs and challenges. In this comprehensive exploration, we will delve into the numerous avenues for future development and enhancement of the application.

1. Enhanced Sentiment Analysis:

Sentiment analysis is a core feature of the "Twitter Analysis Mobile Application." However, there's room for improvement and expansion in this area. Future development can focus on refining sentiment analysis algorithms to enhance accuracy. This includes developing models that can better understand sarcasm, irony, and nuanced expressions in tweets. Moreover, the application can be designed to provide more in-depth sentiment analysis, breaking down sentiment into finer categories, such as joy, anger, sadness, and surprise. These improvements can make the application a more robust tool for understanding public opinion and emotions on Twitter.

2. Multilingual Support:

Twitter is a global platform, and tweets are published in numerous languages. To broaden the application's reach, adding support for multiple languages is essential. Future development can include the integration of multilingual sentiment analysis. This will enable users to analyze tweets in languages other than English and gain insights into the sentiment of a diverse global audience. Additionally, it can provide translation features to help users understand tweets in languages they are not familiar with, further expanding the application's usability.

3. Real-time Trend Analysis:

The current version of the "Twitter Analysis Mobile Application" offers real-time data analysis but has the potential for further enhancement. Future development can focus on providing more comprehensive real-time trend analysis. This includes the ability to track emerging trends, hashtags, and viral topics on Twitter as they develop. Users can receive alerts or notifications when a specific trend is gaining momentum. This feature can be particularly valuable for marketers, news agencies, and social media managers seeking to stay ahead of the curve.

4. User Behavior Prediction:

Understanding user behavior on Twitter is a valuable aspect of social media analysis. Future iterations of the application can delve deeper into user behavior prediction. By analyzing historical data and user interactions, the application can offer insights into how specific users are likely to respond to certain tweets or topics. This can be used for targeted advertising, personalized content recommendations, and user engagement strategies. Predictive analytics can help businesses and individuals make data-informed decisions about their Twitter interactions.

5. Data Visualization Enhancements:

Data visualization is essential for conveying insights effectively. Future developments can focus on enhancing the data visualization capabilities of the application. This includes the integration of more advanced charting and graphing tools to present data in a more visually engaging manner. Users can customize the way data is presented and gain control over how insights are visualized. Interactive data dashboards and reports can provide a dynamic and user-friendly experience.

6. Cross-platform Accessibility:

While the application may already be available on multiple platforms, ensuring seamless accessibility on a wider range of devices and operating systems is a key consideration for the future. This may involve further refinement of the user interface for different device types, such as tablets and smartwatches. Additionally, the development of a web-based version of the application can increase accessibility for users who prefer not to install a mobile app.

7. Integration with Other Social Media Platforms:

While Twitter is a prominent social media platform, users and businesses often have a presence on multiple social networks. The application's future scope can include integration with other major social media platforms like Facebook, Instagram, or LinkedIn. This integration would allow users to analyze and compare data across various social networks, providing a more holistic view of their online presence and audience sentiment.

8. Advanced User Engagement Metrics:

Understanding user engagement is crucial for social media success. Future iterations of the application can offer more advanced user engagement metrics. This includes tracking metrics like click-through rates, conversion rates, and user interaction patterns. Users can gain insights into how their Twitter content is performing and what strategies are most effective in engaging their audience.

9. Enhanced Data Security and Privacy Features:

As data privacy regulations evolve, the application's future development should prioritize enhanced data security and privacy features. This includes compliance with emerging data protection standards and the implementation of advanced encryption methods. Users should have greater control over their data and be able to manage their privacy settings more effectively.

10. Machine Learning and AI Integration:

Machine learning and artificial intelligence can significantly enhance the capabilities of the "Twitter Analysis Mobile Application." Future developments can include the integration of AI-driven features, such as chatbots for user support, predictive analytics for content recommendations, and automated content tagging. These AI-driven features can make the application more intelligent and valuable for users.

11. Collaboration and Team Features:

For businesses and marketing teams, collaborative features are essential. Future scope can involve the development of collaboration tools that allow teams to work together within the application. This includes shared dashboards, collaborative reporting, and team communication features. Such enhancements can make the application more suitable for group analysis and decision-making.

12. Ethical Data Usage Education:

Given the increasing emphasis on ethical data usage, future iterations of the application can include educational resources and guidelines on ethical data analysis and social media usage. This can help users and businesses adhere to ethical standards and legal regulations in their Twitter activities.

13. Integration with Third-party Analytics Services:

To enhance the application's analytical capabilities, integration with third-party analytics services can be considered. This can provide users with access to more advanced data analysis tools and external data sources, expanding the application's utility for data professionals and businesses.

14. Custom Data Sources:

While Twitter is a primary data source, future development can allow users to connect custom data sources, such as proprietary databases, to the application. This flexibility enables businesses to integrate their internal data with Twitter data for more comprehensive analysis and insights.

15. Improved User Training and Documentation:

As the application becomes more feature-rich, providing in-depth user training and comprehensive documentation becomes vital. This can empower users to make the most of the application's capabilities and ensure that they are well-informed about its features.

16. Expanding to New Platforms:

While the application may primarily target mobile platforms, future scope can include expanding to other platforms, such as desktop applications and even smart TVs. This expansion can make the application accessible to a broader range of users.

17. Real-time Crisis Analysis:

In times of crisis, social media plays a crucial role in disseminating information and public sentiment. Future developments can include features for real-time crisis analysis, helping users monitor and respond to critical events and public sentiment during emergencies or crises.

18. Customizable Reporting:

The application can introduce customizable reporting features that allow users to tailor reports to their specific needs. This can include custom data selection, report templates, and branding options. Businesses can use these features for creating professional reports for clients or stakeholders.

19. Gamification and User Engagement Features:

To encourage users to interact with the application regularly, gamification elements can be integrated. This can include achievements, leaderboards, and challenges related to data analysis. Gamification can make the application more engaging and enjoyable for users.

20. Advanced AI-Driven Insights:

Leveraging advanced artificial intelligence, the application can provide predictive insights and recommendations. For example, it can offer recommendations for the best times to tweet, content ideas based on trending topics, and audience engagement strategies.

21. Data Archive and Historical Insights:

Offering users the ability to access and analyze historical Twitter data can be a valuable addition. This includes the creation of a data archive for users, allowing them to explore past trends and sentiment on Twitter.

22. Industry-specific Analysis:

The application can expand its capabilities to offer industry-specific analysis. Users can choose templates and settings tailored to their industry, allowing for more precise insights and recommendations relevant to their field.

23. Enhanced Ethical AI and Bias Mitigation:

Addressing ethical concerns related to AI and machine learning is paramount. Future development can focus on enhanced ethical AI practices, including bias mitigation, transparency, and fairness in algorithmic decision-making.

24. Integration with E-commerce Platforms:

For businesses engaged in e-commerce, integrating the application with e-commerce platforms can provide valuable insights into customer sentiment, product trends, and marketing strategies. Users can gain a competitive edge by analyzing Twitter data in conjunction with their e-commerce activities.

25. Data Monetization Options:

As users contribute to the application's data ecosystem, offering data monetization options can be explored. Users can choose to share their data with researchers or marketers in exchange for rewards or compensation.

26. Enhanced Academic and Research Features:

The application can cater to the academic and research communities by offering advanced research tools and data access. This includes features for conducting large-scale academic studies and accessing comprehensive Twitter datasets.

27. Augmented Reality (AR) and Virtual Reality (VR) Integration:

As AR and VR technologies continue to advance, the application can explore integration with AR and VR platforms, providing users with immersive data analysis

experiences.

28. Voice and Natural Language Interaction:

With the rise of voice assistants and natural language processing, the application can offer voice and text interaction for data analysis. Users can query the application using voice commands or text, making it more accessible and user-friendly.

29. Data Anonymization and Privacy-enhancing Features:

To address evolving privacy concerns, the application can implement advanced data anonymization techniques and privacy-enhancing features. This ensures that user data is protected and anonymized in compliance with stringent data protection regulations.

30. International Expansion and Localization:

To reach a global audience, the application can focus on international expansion and localization. This includes providing support for multiple languages, currencies, and regional insights.

CHAPTER-9

9. CONCLUSION

9.1 Summary of Achievements

Sentiment analysis, a subfield of natural language processing (NLP), has seen significant advancements in recent years, and the application of these techniques to Twitter data has yielded remarkable results. This summary highlights some of the key achievements in the field of Twitter sentiment analysis, covering both the technological advancements and their real-world applications.

9.2 Technological Advancements:

1. **Deep Learning and Neural Networks:** The advent of deep learning techniques, particularly recurrent neural networks (RNNs) and convolutional neural networks (CNNs), has revolutionised sentiment analysis on Twitter. These models are capable of learning complex patterns and nuances in text, making them highly effective in classifying sentiment in short and noisy Twitter data.
2. **Pre-trained Language Models:** The development of pre-trained language models like BERT, GPT-3, and their variants has significantly improved sentiment analysis accuracy. These models are fine-tuned on vast amounts of data, enabling them to capture contextual information and understand sarcasm, irony, and other subtleties in tweets.
3. **Multilingual Sentiment Analysis:** The ability to perform sentiment analysis in multiple languages has become a valuable achievement. Twitter is a global platform, and the ability to analyse sentiment across languages is essential for understanding and responding to the sentiments of diverse user populations.
4. **Real-time Analysis:** Real-time sentiment analysis has become increasingly important for businesses and organisations to monitor and respond to unfolding events and trends on Twitter. Achieving low latency and high accuracy in real-time analysis is a significant technological milestone.
5. **Emoji and Emoticon Interpretation:** Twitter is rich in emojis and emoticons that can convey sentiments. Progress has been made in interpreting and incorporating these symbols into sentiment analysis models, enhancing their accuracy and relevance.

9.3 Real-World Applications:

1. **Brand and Product Monitoring:** Sentiment analysis on Twitter is widely used by businesses to monitor the sentiment surrounding their brands and products. Companies can gauge customer satisfaction, identify issues, and respond to complaints in real time and improving customer service.
2. **Political and Social Trend Analysis:**
Twitter sentiment analysis has been invaluable in understanding political and social trends. By analysing tweets related to elections, policy issues, and social movements, researchers and analysts can gain insights into public sentiment, which can inform strategies and policies.
3. **Customer Feedback and Support:**
Many companies now employ sentiment analysis to categorise and prioritise customer feedback on Twitter. This allows them to identify and address urgent issues, improve their products and services, and maintain a positive customer experience.
4. **Stock Market Predictions:**
Sentiment analysis has found applications in predicting stock market movements. By analysing the sentiment of tweets related to specific companies or financial markets, traders and investors can make more informed decisions.
5. **Crisis Management:**
During crises, such as natural disasters or public health emergencies, Twitter sentiment analysis has played a crucial role in monitoring public sentiment and disseminating accurate information. Governments and emergency responders can use this data to allocate resources and respond effectively.
6. **Brand Campaign Assessment:**
Companies frequently launch marketing campaigns on Twitter, and sentiment analysis is instrumental in assessing their impact. By analysing the sentiment of tweets related to a campaign, businesses can adjust their strategies and assess the return on investment.
7. **Content Recommendation:**
Social media platforms use sentiment analysis to recommend content to users. By understanding the sentiment of users' posts and interactions, platforms can offer more personalised and engaging content.
8. **Hate Speech and Cyberbullying Detection:**
Sentiment analysis is used to identify hate speech and cyberbullying on Twitter, contributing to a safer online environment. This is vital for protecting users and enforcing community guidelines.

In conclusion, Twitter sentiment analysis has made remarkable strides in both technological advancements and real-world applications. It has become an essential tool for businesses, researchers, governments, and organisations to understand and respond to public sentiment on this influential social media platform. As NLP technologies continue to evolve, we can expect even more sophisticated and accurate sentiment analysis in the future, further enhancing its utility and impact in various domains.

9.4 Contributions to the Field

Twitter sentiment analysis has made significant contributions to the field of natural language processing (NLP) and beyond. This summary highlights some of the key contributions and advancements in the field, demonstrating how it has enriched our understanding of social media sentiment and impacted various sectors.

1. Insights into Human Sentiment:

One of the primary contributions of Twitter sentiment analysis is its ability to provide valuable insights into human sentiment on a large scale. By analysing the millions of tweets posted daily, researchers and analysts can gain a deeper understanding of how people feel about a wide range of topics, from political events to product preferences. This has profound implications for social and market research, as well as public opinion analysis.

2. Real-time Monitoring:

Twitter sentiment analysis enables real-time monitoring of public sentiment. In today's fast-paced digital world, this capability is invaluable. It allows businesses and organisations to respond promptly to emerging trends and issues, which can be particularly useful in crisis management, customer support, and social activism. Real-time monitoring also aids in tracking the impact of marketing campaigns and tracking brand sentiment.

3. Political Analysis:

Twitter has become a significant platform for political discourse and expression. Sentiment analysis of political tweets has provided crucial insights into public opinion during elections, policy debates, and international events. It helps political analysts and campaigns gauge public sentiment, detect shifts in voter preferences, and identify areas of concern or support.

4. Business and Market Intelligence:

For businesses, Twitter sentiment analysis has opened new doors to understanding consumer sentiment and market trends. By monitoring tweets related to their products or services, companies can identify areas for improvement, detect emerging issues, and gauge customer satisfaction in real time. This information can drive strategic decisions, product development, and marketing campaigns.

5. Predictive Analytics:

The field of Twitter sentiment analysis has contributed to the development of predictive analytics. By examining historical tweet data and sentiment trends, analysts can make predictions about future events, including stock market movements, public sentiment shifts, and the success of upcoming product releases. This is especially valuable for traders, investors, and businesses.

6. Social Issue Advocacy:

Social activists and organisations working on various causes have benefited from Twitter sentiment analysis. They can monitor public sentiment surrounding their issues and campaigns, adapt their strategies accordingly, and mobilise support effectively. It has become a tool for raising awareness and rallying communities around important social issues.

7. Content Recommendation:

Major social media platforms leverage sentiment analysis to recommend content to users. By understanding the sentiment behind users' interactions and posts, these platforms can deliver more personalised and engaging content, increasing user satisfaction and retention.

8. Crisis Management:

During crises such as natural disasters, public health emergencies, or social unrest, Twitter sentiment analysis plays a critical role in crisis management. Governments, emergency responders, and healthcare organisations can monitor public sentiment to allocate resources efficiently, provide timely information, and address concerns.

9. Sentiment Lexicon and Datasets:

The development of sentiment lexicons and datasets for Twitter has contributed to the field of NLP. These resources have facilitated the training and evaluation of sentiment analysis models. Researchers have created comprehensive datasets containing tweets labelled with sentiment scores, enabling the development and benchmarking of sentiment analysis algorithms.

10. Multilingual Analysis:

Twitter sentiment analysis has expanded beyond English, making significant contributions to multilingual NLP. Researchers have developed models and tools that can analyse sentiment in multiple languages, reflecting the global nature of the platform and enabling cross-cultural sentiment analysis.

11. Emotion and Emoji Analysis:

Incorporating emotions and emojis into sentiment analysis models has been a valuable contribution. Understanding the emotional context of tweets and interpreting emojis allows for a richer and more nuanced analysis of sentiment, capturing subtleties that text alone may miss.

12. Detection of Hate Speech and Cyberbullying:

Sentiment analysis models have been adapted to detect hate speech and cyberbullying on Twitter. This is a significant contribution to online safety and the enforcement of community guidelines. It helps social media platforms create safer and more inclusive online environments.

In summary, Twitter sentiment analysis has made substantial contributions to NLP, market research, political analysis, and various societal domains. It provides insights into human sentiment, real-time monitoring, and predictive capabilities. It has empowered businesses, governments, and social activists to better understand, engage with, and respond to the Twitter verse. As NLP technologies continue to evolve, Twitter sentiment analysis will likely contribute even more to our understanding of online sentiment and behaviour.

9.5 Future Work and Recommendations

Future Work and Recommendations in Twitter Sentiment Analysis

Twitter sentiment analysis has made substantial progress, but there are several avenues for future work and key recommendations that can further advance the field and its applications. The following insights provide a roadmap for researchers, developers, and stakeholders:

1. Improved Sentiment Understanding:

To enhance the quality of sentiment analysis, future research should focus on better understanding the nuances of human sentiment. This includes the development of models that can identify mixed sentiments, contradictory opinions, and evolving sentiment over time. A more sophisticated sentiment lexicon that accounts for cultural and contextual variations would be beneficial.

2. Contextual Analysis:

Integrating contextual information into sentiment analysis models is crucial for better accuracy. Context, such as the conversation thread, user profiles, and trending topics, can significantly affect the interpretation of sentiment in tweets. Models that can capture and adapt to these contextual factors will yield more precise results.

3. Sarcasm and Irony Detection:

Twitter is replete with sarcasm and irony, which can confound sentiment analysis models. Future work should focus on developing techniques to identify and interpret these forms of expression accurately. Advanced machine learning models, such as transformer-based architectures, may offer a way to tackle this challenge effectively.

4. Multimodal Analysis:

Expanding sentiment analysis beyond text to include images and videos is essential in the age of multimedia-rich social media. Developing models that can analyse visual and auditory content for sentiment will provide a more comprehensive understanding of user sentiment and behaviour.

5. Bias Mitigation and Fairness:

Ensuring that sentiment analysis models are fair and unbiased is paramount. Researchers should work on reducing inherent biases in training data and models. Tools for bias measurement and mitigation should be integrated into the sentiment analysis process, with a focus on providing equitable results for all demographic groups.

6. Customizable Sentiment Analysis:

The ability to customise sentiment analysis models for specific domains and industries is valuable. Tailored models for healthcare, finance, politics, or entertainment can offer more accurate insights by accounting for domain-specific terminology and contexts.

Researchers and developers should provide tools to adapt models for specialised use cases.

7. Privacy-Preserving Techniques:

As privacy concerns continue to grow, incorporating privacy-preserving techniques into sentiment analysis is crucial. Researchers should explore methods for sentiment analysis that do not compromise user privacy while still providing valuable insights.

8. Longitudinal Analysis:

Understanding how sentiment evolves over time is vital for tracking trends and public opinion changes. Longitudinal sentiment analysis can provide insights into the impact of events, policies, and social movements over extended periods. Researchers should develop methodologies for this type of analysis.

9. Human-in-the-Loop Approaches:

Combining machine intelligence with human judgement can improve the reliability of sentiment analysis. Hybrid approaches that allow human annotators to validate or correct machine-generated sentiment labels can enhance accuracy, particularly in nuanced cases.

10. Cross-Platform Analysis:

Expanding sentiment analysis to encompass multiple social media platforms can provide a more comprehensive view of user sentiment. Comparative analysis of sentiment across platforms can help identify patterns and variations in user behaviour and sentiment expression.

11. User Experience Enhancement:

For practical applications, sentiment analysis tools should be user-friendly and accessible. Developers should focus on creating intuitive interfaces, APIs, and software libraries that make sentiment analysis easily accessible to a wider audience, including individuals and small businesses.

12. Public Awareness and Education:

Raising awareness about the capabilities and limitations of sentiment analysis is essential. Researchers, practitioners, and educators should collaborate to provide educational resources and guidelines for responsible usage. Users should understand how their data is used and be informed about the implications of sentiment analysis in decision-making processes.

13. Ethical Considerations:

Ethical guidelines and regulations for sentiment analysis should be developed and adhered to. Future work should ensure that sentiment analysis is used responsibly and transparently, avoiding any unintended consequences or misuse of the technology.

In summary, the future of Twitter sentiment analysis involves refining models, addressing challenges related to context and language, embracing multimodal analysis, and promoting fairness and privacy. Collaborative efforts between researchers, industry experts, and policymakers are essential to ensure that sentiment analysis remains a valuable tool for understanding and engaging with the vast and dynamic landscape of social media data.

CHAPTER-10

10.REFERENCES

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