COMSATS UNIVERSITY ISLAMABAD

DEPARTMENT OF COMPUTER SCIENCE

Sentimental Analysis System on the basis of Text, Emoticons and Acronyms

By

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Supervisor
Maheen Gull

Bachelor of Science in Computer Science (2020-2024)

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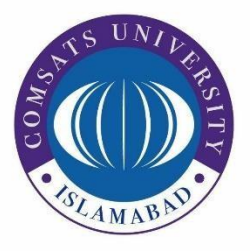
The candidate confirms that the work submitted is their own and appropriate credit has been given where reference has been made to the work of others.



COMSATS University, Islamabad Pakistan

Sentimental Analysis System on the basis of Text, Emoticons and Acronyms

A project presented to

COMSATS Institute of Information Technology, Islamabad

In partial fulfillment of the

requirement for the degree of

Bachelor of Science in Computer Science (2020-2024)

By

Abdul Basit **CIIT/FA20-BCS-008/VHR**

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Abdul Basit

Muhammad Maaz

CERTIFICATE OF APPROVAL

It is to certify that the final year project of BS (CS) "Sentimental Analysis System on the basis of Text, Emoticons and Acronyms" was developed by **Abdul Basit (CIIT/FA20-BCS-008)** and **Muhammad Maaz (CIIT/FA20-BCS-036)** under the supervision of "**Maheen Gull**" and that in (their/his/her) opinion; it is fully adequate, in scope and quality for the degree of Bachelors of Science in Computer Sciences.

Supervisor

External Examiner

Head of Department

(Department of Computer Science)

Executive Summary

Sentiment Analysis, also known as Opinion Mining, is a crucial technology in today's digital landscape, aimed at understanding public sentiments and opinions from vast textual data available online. This project focuses on developing an advanced Sentiment Analysis system integrating Natural Language Processing (NLP) and Machine Learning (ML) techniques to analyze public sentiments effectively. The system aims to improve sentiment classification accuracy by addressing challenges posed by emoticons and acronyms commonly used in online text.

The primary objective of this project is to implement a machine learning algorithm capable of performing sentiment analysis on textual data. Leveraging NLP techniques, the system will process and analyze text to determine whether the sentiment expressed is positive or negative. Through the integration of emoticon and acronym recognition, the system will enhance accuracy in sentiment classification, particularly in scenarios such as analyzing product reviews on e-commerce platforms.

This system proposed in this project seeks to leverage advanced technologies like NLP and ML to process and understand public opinions effectively, ultimately empowering businesses and consumers with valuable insights derived from vast amounts of online textual data.

Acknowledgement

All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge by virtue of which we were able to accomplish this challenging task.

We are greatly indebted to our project supervisor “Maheen Gull”. Without their personal supervision, advice and valuable guidance, completion of this project would have been doubtful. We are deeply indebted to them for their encouragement and continual help during this work.

And we are also thankful to our parents and family who have been a constant source of encouragement for us and brought us the values of honesty & hard work.

Abdul Basit

Muhammad Maaz

Abbreviations

SRS	Software Require Specification
SAS	Sentiment Analysis System
NLP	Natural Language Processing
NLTK	Natural Language Toolkit
TF-IDF	Term Frequency-Inverse Document Frequency

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1 INTRODUCTION

Today, feelings and opinions of people, particularly about some product or issue, is something which is quite relevant and essential to gain. And that is precisely where Sentiment Analysis comes to the rescue. That's like a bright helper that scans tons of messages on the web and determines if they are joyful or sad. Natural language processing and other cool things like artificial intelligence and machine learning help to do this. For instance, consider websites that sell products online and create customer spaces where customers share their experience of what they purchased. Indeed, since there are many reviews, shopping gets difficult due to the overwhelming flow of information. But that is why, for example, Sentiment Analysis is useful because sometimes there are a lot of reviews and one has no time to read through all of them and just need the general idea of people's opinion. Well, it is like having an assistant who assists in making decisions, though without speaking ability.

1.1 System Introduction

The emotions of textual data is determined and handled in what is called Sentiment Analysis. In other words, the Sentiment Analysis identifies if the presented information is positive or negative concerning a particular subject or marketing item. Because of this scenario it is important to note it is widely referred to as Opinion Mining. To the analysis of textual information, Sentiment Analysis uses techniques borrowed from NLP – Natural language processing, as well as AI and ML – Artificial Intelligence and Machine learning. Thus in conclusion, analysis of sentiment gives insight to what people think of a particular topic or product. Overall, Sentiment Analysis is capable of capturing the information regarding the people's sentiment or opinion about some specific product and make a basis of its evidentiary and rationales.

From Sentiment Analysis, there is a lot of textual information available in internet and it will predict the future prospect of the organization and help the public to construct their decision relate to their purchase. For example, in an e-commerce website, a person buys a product and gives the testimonial based on the experience with or without the use of the particular product. These reviews help to the customers who want to buy the product or the

item. The challenge here is that as the number of reviews increases the customers themselves may find it having to read all the reviews. Therefore, there is requirement of an automatic system which may provide an appropriate conclusion about this quarter's particular product or topic and this task is called Sentiment Analysis.

1.2 Background of the System

Sentiment analysis, also referred to as the 'subjective analysis of text,' is the computational study of opinions or attitudes toward certain situations or ideas. Earlier in number of sentiment analysis systems have been developed but most of present day sentiment analysis systems are not possess the competency to analyze Emoticons and Acronyms present in the text corpus. This research work is aimed at suggesting a model for SA to enable it address opinionated texts as well as Emoticons and acronyms for the purpose of improving the performance of the sentiment classification. Twitter opinion mining will be the interaction of the proposed emoji and acronym features which are not incorporated in current studies.

1.3 Objectives of the System

Well, the goal of Sentiment Analysis System is to analyze this data in other to derive vital information on the citizens' opinion that would aid better decision making in the business world and enhanced usage of products.

The objectives of Sentimental Analysis System are following:

- They have to incorporate an algorithm for ML and perform the sentiment analysis.
- The basic concept of NLP and the various techniques used in Natural Language Processing should be fully understood and incorporated into the daily practice.
- Obtain higher accuracy in relabeling.
- While implementing the models it also involves creating a web application graphical user interface for visualization.

1.4 Significance of the System

Precisely, Sentiment Analysis is a critical process employed in arriving at the overall views of the public from extremely large textual data, especially over social media, leveraging on NLP and ML. In this way, by emphasizing emoticons and acronyms, it increases the efficiency of the identification of sentiments, which will serve the overall interest of organizations as well as the consumer in decision-making regarding the e-commerce segment. The goals are to create a simple front-end to the web application and improve accuracy of the machine learning algorithm making the web app more beneficial for users and other applications in business and consumer decisions.

2 REQUIREMENT SPECIFICATIONS

The Requirement Specifications chapter identifies the requirement or need for and the operation function of the Sentiment Analysis System along with the overall purpose and key things that have to happen to make the system work.

2.1 Product Scope

The Sentiment Analysis System is like a smart tool that reads what people say online and figures out if they're happy or unhappy about things, like products or topics. It uses fancy technologies to understand all the words and even emoticon people use. Unlike other tools, it pays attention to details like emoticons and acronyms. The main goal is to make a simple website where you can see the results showing how people feel. This tool is super helpful for companies to make better decisions, and for regular people to choose products wisely. The aim is to make it really good at understanding opinions, reaching a high accuracy level, and making it easy for everyone to use.

2.2 Product Description

2.2.1 Product Perspective

The Sentiment Analysis System is a standalone application designed to operate within the context of social media platforms. It acts as an analytical layer, extracting sentiments from textual content, emoticons, and acronyms used in online communication. SAS is not a follow-on member of any existing system but is intended to complement and enhance the capabilities of social media platforms by providing a more comprehensive analysis of user sentiments.

2.2.2 Product Functionality

Following are the product functionality of the proposed Sentiment analysis software:

- **Textual Sentiment Analysis:** Classify the sentiment of textual content as positive or negative.
- **Emoticon Sentiment Analysis:** Interpret emoticons to determine the emotional tone of the message.

- **Acronym Sentiment Analysis:** Identify and interpret acronyms within the context of the message.
- **Combined Sentiment Analysis:** Integrate textual, emoticon, and acronym analyses for a comprehensive sentiment evaluation.
- **User Dashboard:** Provide users with a visually friendly dashboard displaying sentiment analysis results.

2.2.3 Users and Characteristics

Following are the users and characteristics of the Sentiment Analysis system:

- **Characteristics:** General social media platform users.
- **Pertinent Characteristics:** Frequent use of social media, diverse expertise.

2.2.4 Operating Environment

The Sentiment Analysis System is designed to operate in the following environment:

- **Hardware Platform:** Standard servers with adequate processing power and storage capacity.
- **Operating System:** Compatible with Linux and Windows operating systems.
- **Software Components:** Requires Python runtime environment (e.g., PyCharm, Jupyter Notebook)

Dependencies include natural language processing libraries (e.g., NLTK).

2.3 Specific Requirements

2.3.1 Functional Requirements

Engine Functional Requirements are given below:

2.3.1.1 Collecting Data:

To gather data for the sentiment analysis, a dataset was obtained from Kaggle. The dataset likely contains text data annotated with sentiment labels (positive or negative) and is used for training and evaluating the sentiment analysis model.

2.3.1.2 Preprocessing of Data:

In sentiment analysis preprocessing, emoticons (e.g., :) or :() and acronyms (e.g., "OMG") are recognized and preserved to capture their emotional meaning accurately during analysis. They are tokenized and represented consistently for effective sentiment assessment.

2.3.1.3 Test the Classification Algorithm:

Before deploying the sentiment analysis model, it's crucial to thoroughly test the classification algorithm. This involves using a separate set of data (testing data) to evaluate the model's performance and accuracy.

2.3.1.4 Testing and Validation of Model:

The model should be validated using a different set of data to ensure its generalizability. Validation helps in assessing the model's ability to make accurate predictions on new, unseen data.

2.3.1.5 Train an Additional Machine Learning Algorithm for Comparison:

To enhance the system's robustness, an additional machine learning algorithm is trained. This serves as a benchmark for comparison with the main algorithm, helping to evaluate which one performs better in terms of accuracy and efficiency.

2.3.1.6 Fine-Tune the Main Model:

Testing and validation results show that the main sentiment analysis model may require some “tweaking”. This involves a tuning process or making modifications that aims at optimizing the performance of the AI model.

Graphical User Interface Function Requirements are given below:

2.3.1.7 Include Textual Input Field on which Sentiment Analysis is Performed:

There should be an input text bar to allow the users feed in the text that they intend to analyze for sentiment. This field provides a means with which the users are able to connect with the sentiment analysis system.

2.3.1.8 Output Stream Chart in Real Time:

A real-time output stream chart visually represents the sentiment analysis results. This could be a graphical representation, such as a line chart or bar graph, updating dynamically as the analysis is performed.

2.3.2 Behavioral Requirements

Behavioral requirements specify how the system behaves in response to different inputs and under various conditions.

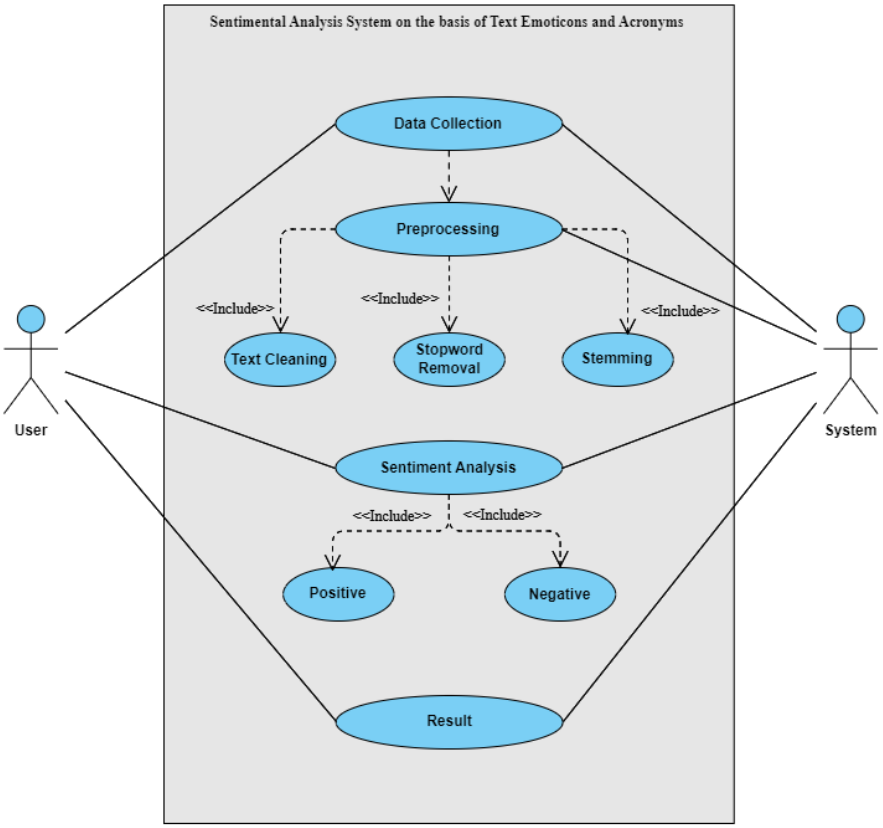

Figure 1 Use Case Diagram

2.3.3 External Interface Requirements

2.3.3.1 User Interface

Following are the interfaces of our system:

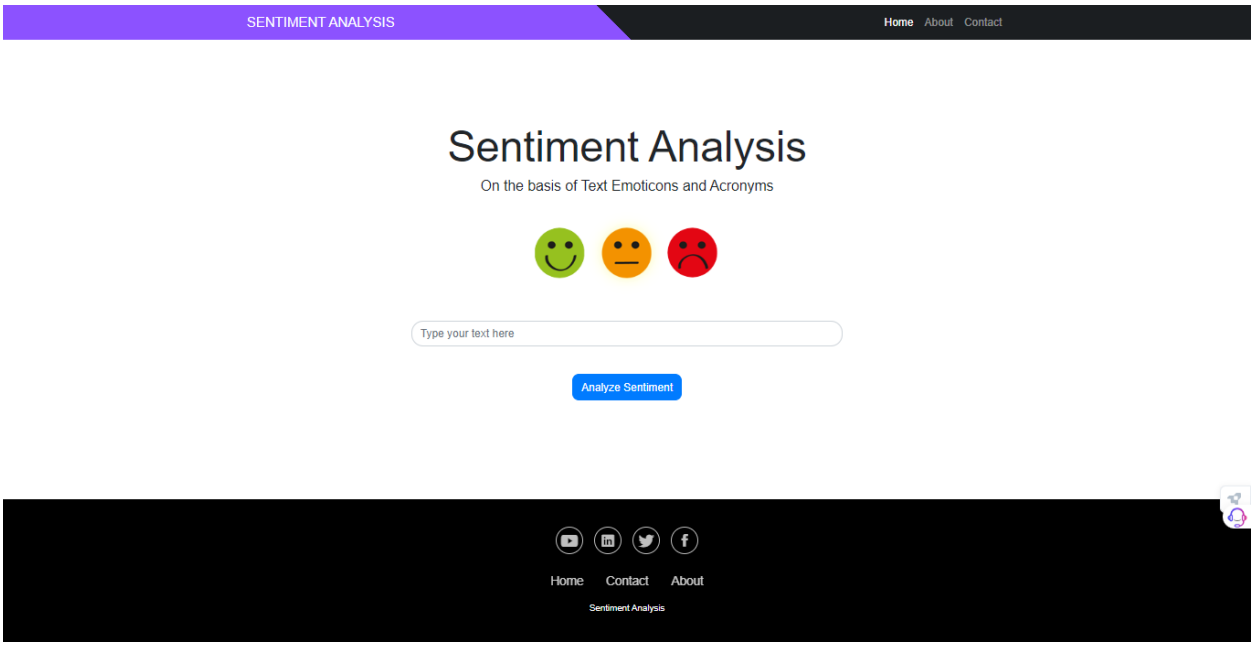

Figure 2 Main interface of the System

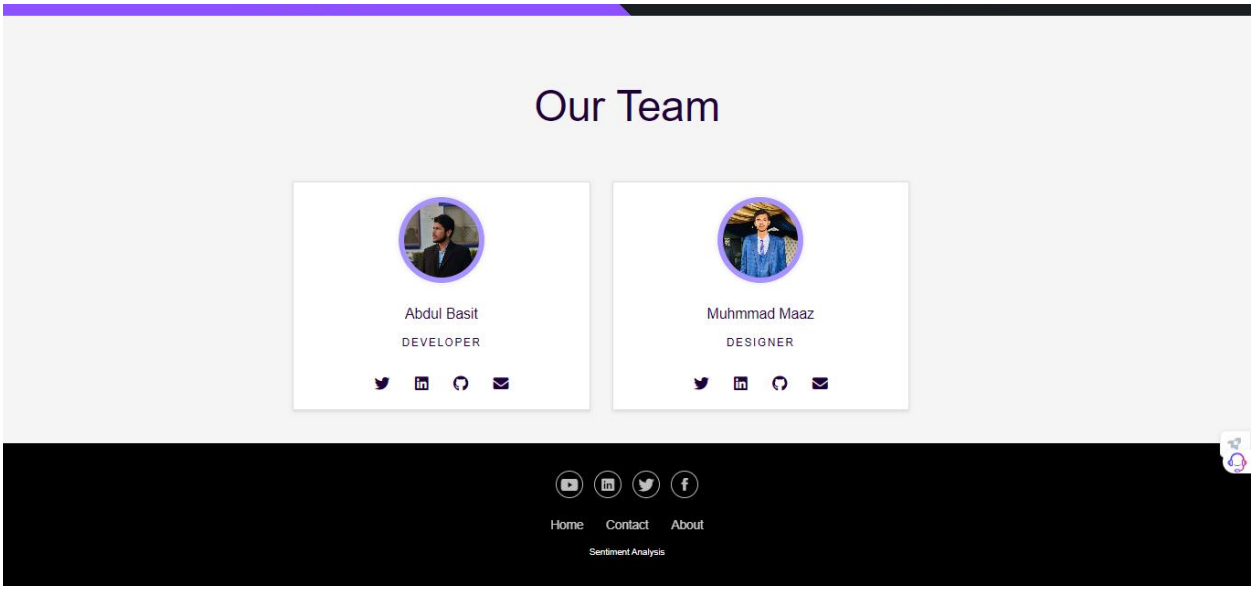

Figure 3 Our Team Page

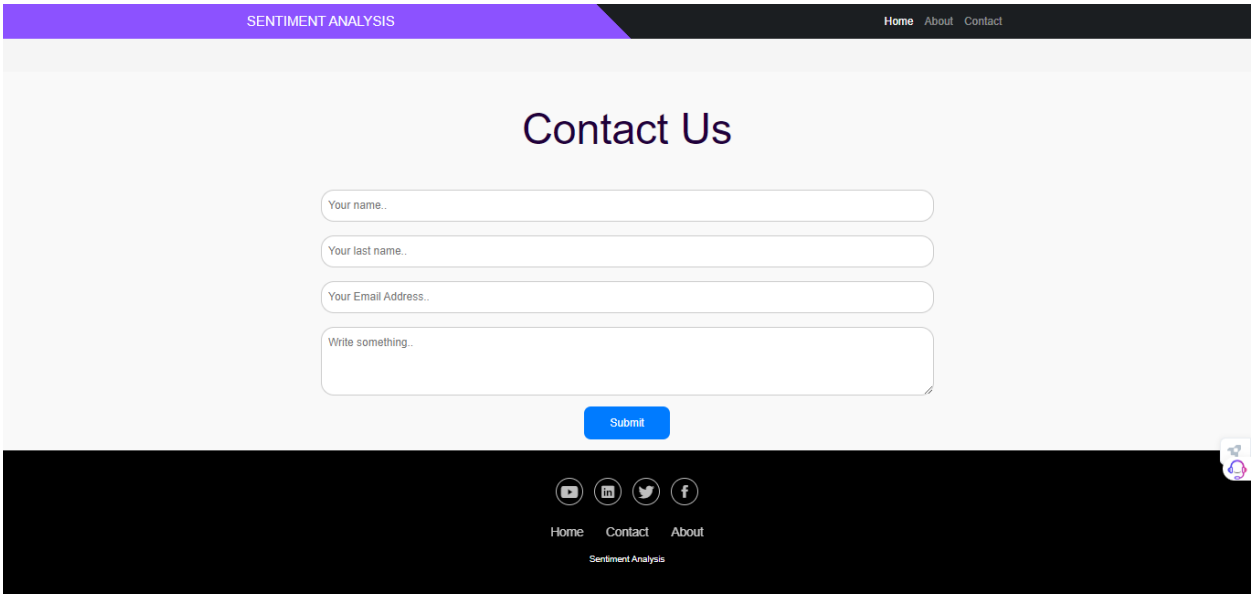

Figure 4 Contact Us page

2.4 Non-functional Requirements

Non-functional Requirements are essential guidelines for the Sentiment Analysis System that go beyond basic functions.

2.4.1 Performance Requirements

The performance requirements of the proposed sensitivity analysis algorithm are as follows:

- **Response Time:** The sensitivity analysis system will produce sensitivity analysis within 5 seconds for 95% of queries.
- **Scalability:** The system should gracefully scale to handle a 20% increase in the amount of data processed during peak hours, without significant performance degradation.

2.4.2 Safety and Security Requirements

The following are the safety and security requirements of a sentiment analysis system:

- **Regular Security Checks:** Conduct regular security audits of the system to identify and address potential vulnerabilities.

2.4.3 Software Quality Attributes

The software quality characteristics behind the proposed Sentiment Analysis framework are:

2.4.3.1 Reliability

- **Resource availability:** SAS must have at least 99.9% uptime to ensure continuous availability for users.
- **Error handling:** The system should debug gracefully and provide meaningful error messages to users.

2.4.3.2 Maintainability

- **Modularity:** SAS should be designed with a modular architecture that allows for easy updates and changes.
- **Documentation:** Provide complete documentation on system design and algorithms to support ongoing maintenance.

2.4.3.3 Usability

- **User Interface Intuitiveness:** The presentation of the sentiment analysis interface should be easy to understand and may not be complex, and users should understand the result without taking too much time of training.
- **Accessibility:** The emphasis should be made on making the SAS interface usable for the disabled with compliance of the interface to the requirements of Web Content Accessibility Guidelines.

2.4.3.4 Performance Efficiency

- **Resource Consumption:** The system should optimize resource consumption, reduce CPU memory consumption and increase overall performance.

3 DESIGN SPECIFICATIONS

In the Design Specifications chapter, we specify how the Sentiment Analysis System will be designed and how its components will function to meet the requirements. This section covers data flow, software architecture, and user interface design, and provides a clear framework for development and implementation.

3.1 Introduction

Chapter 3 introduces the layout principles of the Sentiment Analysis System, emphasizing its structure, information managing for intuitive sentiment evaluation tasks.

3.2 Composite Viewpoint

The Composite Viewpoint section in Chapter 3 provides general information about Sentiment analysis which identifies the system structure, the combination of components and data flows.

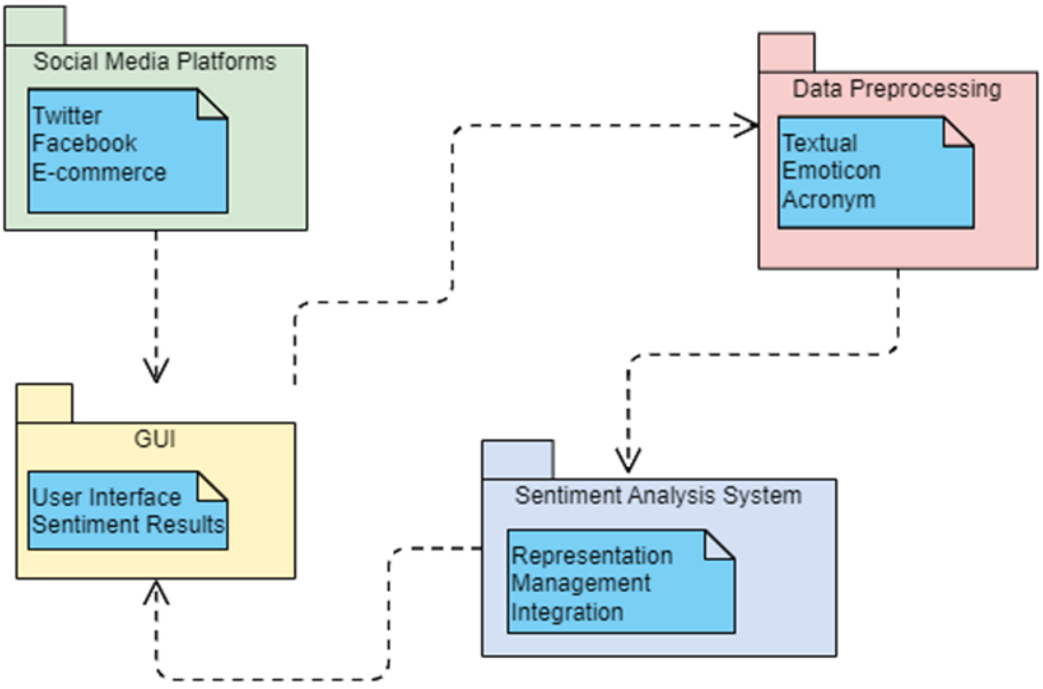

Figure 5 Package Diagram

3.3 Logical Viewpoint

The logical viewport section in Chapter 3 describes the architecture and structure of the logic analysis system, and describes how different modules and objects interact to process and analyze textual content for logic analysis.

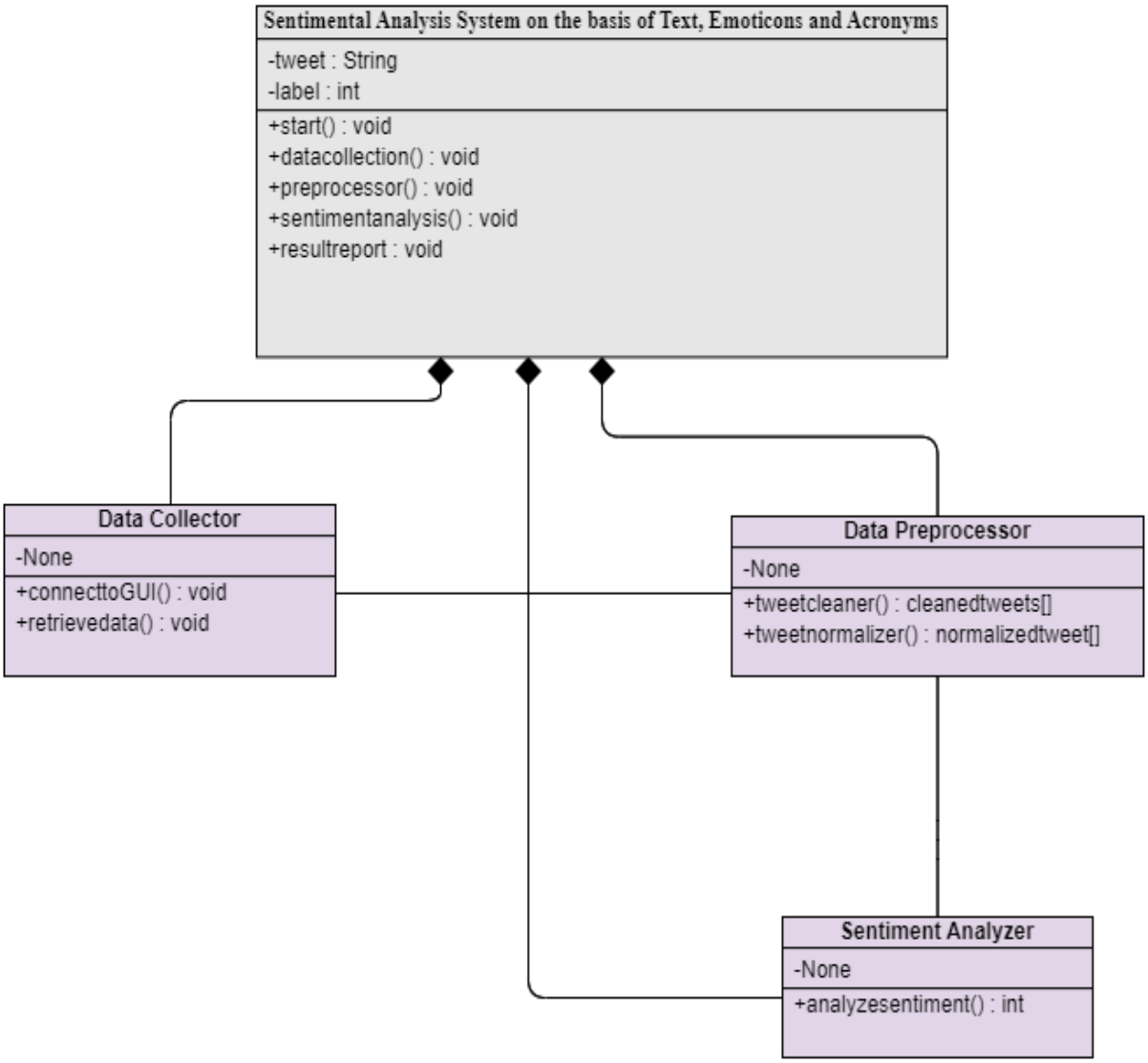

Figure 6 Class Diagram

3.4 Interaction Viewpoint

The communication approach in Chapter 3 illustrates how the components of a sentiment analysis system interact with each other and with external factors, and shows the system flow of data and control during operation.

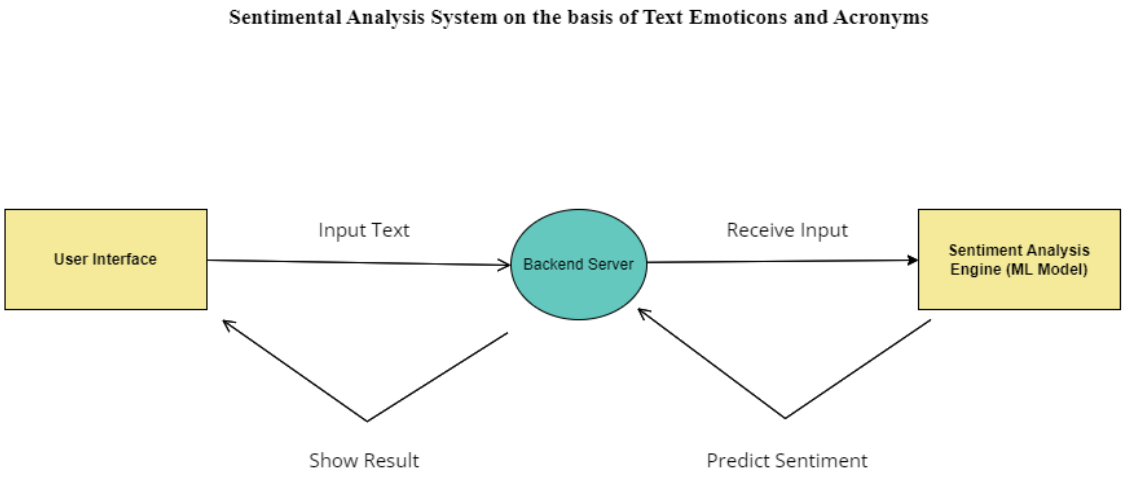

Figure 7 Data Flow Diagram Level 0

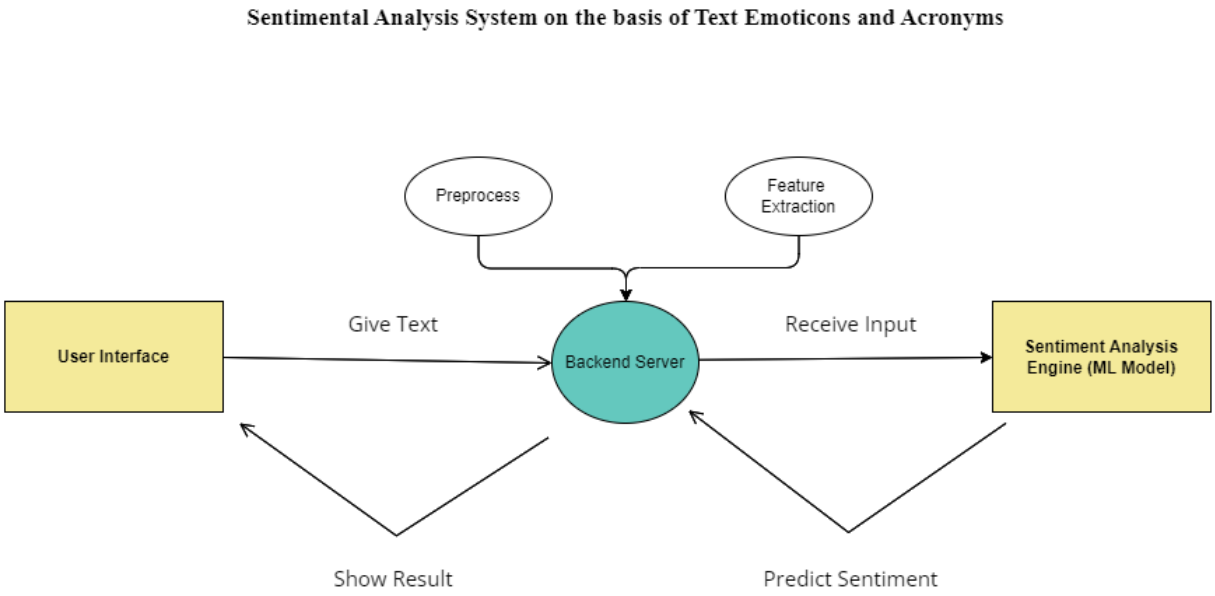

Figure 8 Data Flow Diagram Level 1

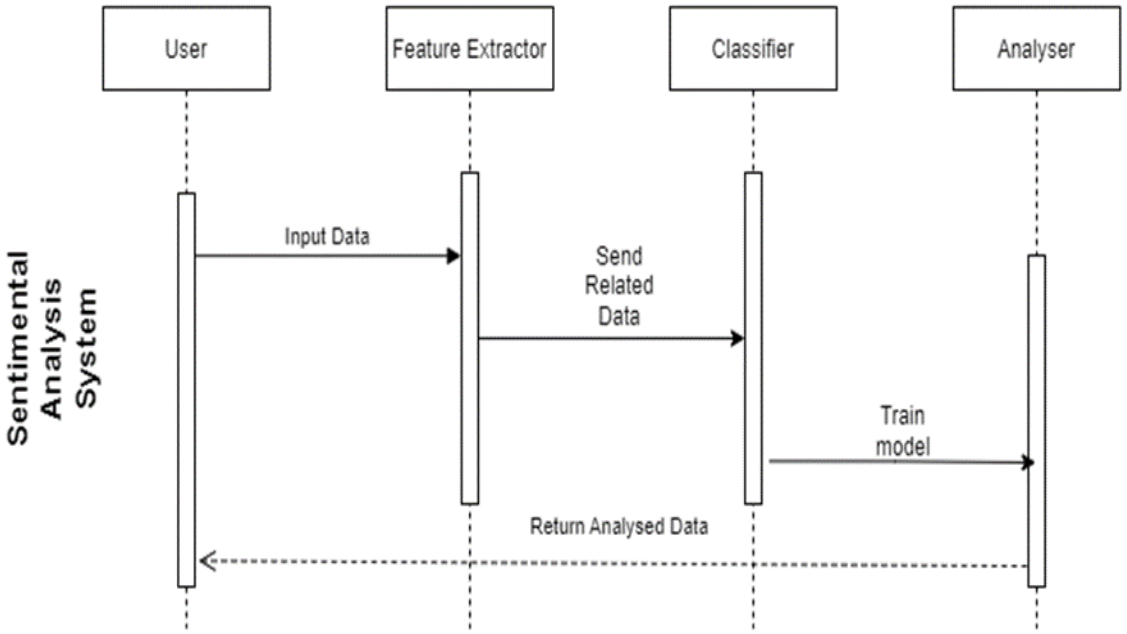

Figure 9 Sequence Diagram

3.5 State Dynamics Viewpoint

The State Dynamics Viewpoint in Chapter 3 describes how the Sentiment Analysis System transitions between different states and conditions during its operation, illustrating the dynamic behavior of the system over time.

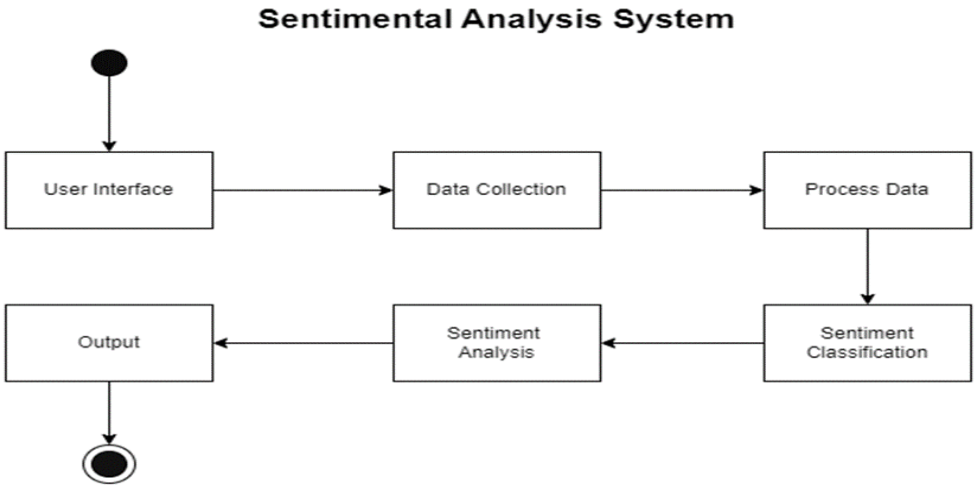

Figure 10 State Machine Diagram

3.6 Algorithmic Viewpoint

Following are the algorithm viewpoints of the proposed Sentiment Analysis system:

3.6.1 Textual Analysis Algorithm:

Analyzes sentiment in textual content using a combination of rule-based preprocessing and machine learning-based classification as follows:

Preprocessing:

- Convert text to lowercase.
- Expand contractions (e.g., "can't" to "can not").
- Remove stop words and punctuation.
- Replace emoticons with corresponding text.
- Normalize and clean text including URLs, digits, and repeating characters.
- Convert chat abbreviations to full words.
- Tokenize text into sentences.
- Apply stemming to words.

Vectorization:

- Use a pre-trained vectorizer (loaded_vectoriser) to transform processed text into numerical features suitable for the machine learning model.

Machine Learning Model:

- Loaded the Support Vector Machine (SVM) model which would help predict the text sentiment as either positive or negative based on the vectorized text.

3.6.2 Emoticon Analysis Algorithm:

Determines sentiment based on emoticons present in the text as following:

- Emoticons are identified and replaced with corresponding sentiment labels during the preprocessing step (e. g. , ":Correspondingly, the words and phrases have been substituted: “:)” with “happy” and “:(“ with “sad”.
- This mapping enables incorporation of emoticon sentiment into the over main sentiment result.

3.6.3 Acronym Analysis Algorithm:

Analyzes sentiment conveyed by acronyms (e. g. “GTH” "OMG") as following:

- Slang words are identified during the preprocessing and later on are expanded into base forms using slang dictionary known as slang_dict.
- This conversion makes it possible getting the sentiment carried by acronyms into the sentiment analysis.

3.6.4 Integration Algorithm:

It combines the results of textual analysis, sentiment analysis, and acronym analysis to provide comprehensive sentiment results.

4 DEVELOPMENT AND TOOLS

In this chapter, information on the development process as well as the tools adopted in the generation of the Sentiment Analysis System are presented. It includes the selection of the team, the growth's program, the used tools, and the outlook of the future.

4.1 Introduction

The chapter "Development and Tools" provides insight into the process of conducting a sentiment analysis process, detailing the team members, the development process, the tools used, and future possibilities.

4.2 Development Plan

This project is managed by a team consisting of two members:

- Abdul Basit
- Muhammad Maaz

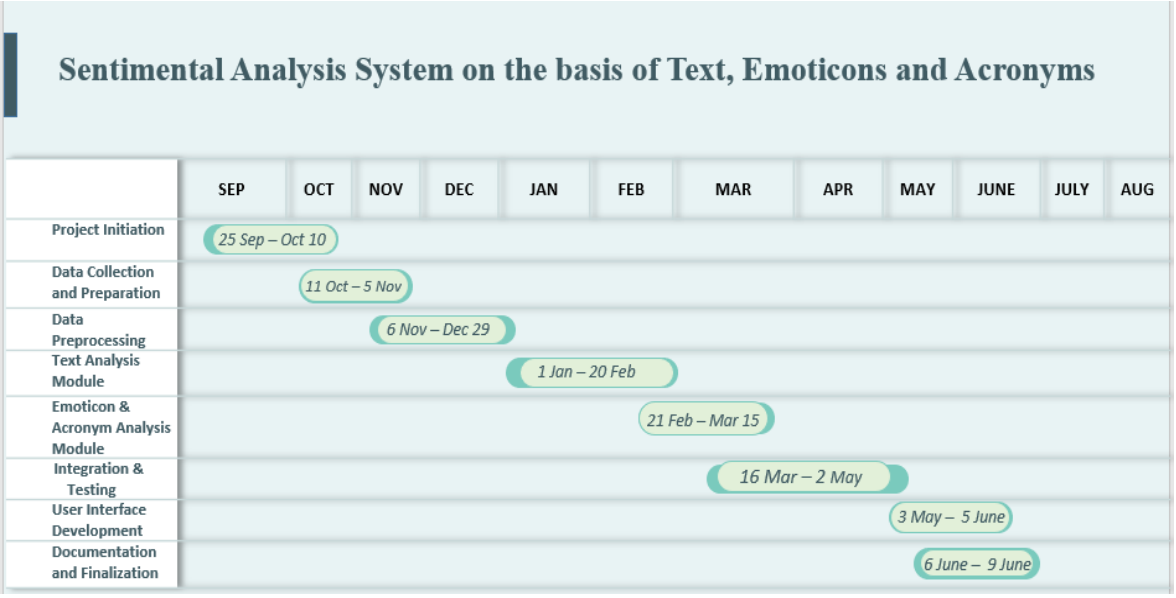

Figure 11 Gant Chart

4.3 Development Tools

The following tools were used for the sensitivity analysis process.

- **Python:** Programming language for development.
- **PyCharm:** An Integrated Development Environment (IDE) for coding.
- **Jupyter Notebook:** An interactive development environment for data analysis and visualization.
- **NLTK (Natural Language Toolkit):** A library of natural language processing tools.
- **Scikit-learn:** Machine learning library for building models.
- **Flask:** web framework for building GUI.

4.4 Conclusion and Future Work/Extensions

In conclusion, the sentiment analysis process provides a valuable tool for understanding public opinion. Future expansions could include the following:

- Implementing real-time analysis capabilities.
- Enhancing the GUI with more interactive features.
- Expanding data sources and languages supported for a broader analysis scope.

5 QUALITY ASSURANCE

The "Quality Assurance" chapter provides a basis for testing the reliability of sentiment analysis due to the presented test methods, procedures, and quality assurance procedures.

5.1 Introduction

This chapter focuses on the quality assurance phase, which ensures reliability and validity in the sentiment analysis process. This includes testing methodologies, control tests, and procedures designed to provide a smooth and error-free user experience.

5.2 Traceability Matrix

This section provides a traceability matrix that links the test cases to the operational requirements for system quality.

Table 1 Traceability Matrix

Requirement Number	Requirement Description	Status	Test Case	Design Component / Module
2.3.1.1	Collecting Data	Pass	TC-001	Data Collection Module
2.3.1.2	Preprocessing of Data	Pass	TC-002	Preprocessing Module
2.3.1.3	Test Classification Algorithm	Pass	TC-003	Machine Learning Model
2.3.1.4	Testing and Validation of Model	Pass	TC-004	Machine Learning Model
2.3.1.5	Train Additional ML Algorithm	Pass	TC-005	Machine Learning Module
2.3.1.7	Perform Textual Sentiment Analysis	Pass	TC-006	GUI Input Interface
2.3.1.8	Display Real-Time Output Stream	Pass	TC-007	Real-Time Output Component

5.3 Test Plan

The Test Plan describes the general testing approach and test scenarios implemented for the Qualitative Analysis program's verification and validation.

Table 2 Test Plan for Sentiment Analysis

Test ID	Test Name	Date of Test	Expected Output	Actual Output	Test Role (Actor)	Test Verified by
SA-001	System Initialization	18/04/2024	Home screen displayed prompting user to input text for sentiment analysis	Home screen displayed	Basit	Maaz
SA-002	Textual Analysis Algorithm	20/04/2024	Positive sentiment identified in input text	Positive sentiment identified	Maaz	Basit
SA-003	Emoticon Analysis Algorithm	24/04/2024	Positive sentiment identified based on emoticons	Positive sentiment identified	Basit	Maaz
SA-004	Acronym Analysis Algorithm	25/04/2024	Positive sentiment identified based on acronyms	Positive sentiment identified	Basit	Maaz
SA-005	Integration Algorithm Test	29/04/2024	Combined sentiment analysis results are accurate	Combined sentiment analysis results accurate	Maaz	Maaz

6 USER MANUAL

The user manual provides detailed instructions on how to use and navigate the sentiment analysis system, including step-by-step instructions and user-interactive diagrams.

6.1 Introduction

This chapter introduces the user manual, identifies its purpose and how to use it effectively to go through and implement the sentiment analysis process.

6.2 Hardware/Software Requirements for the System

Hardware/Software requirements of this proposed system are as follows:

- **Hardware Requirements:** Standard servers with adequate processing power.
- **Operating System:** Compatible with Linux and Windows operating systems.
- **Software Components:** Python runtime environment (e.g., PyCharm, Vs Code).
- **NLTK:** Natural language processing library.

6.3 Installation guide for Application

Download Python:

- Visit the official Python website (https://www.python.org/downloads/)

Install Required Libraries using pip:

- Open a command prompt or terminal.
- **Flask:** It's a micro web framework for Python used to develop web applications. pip install Flask
- **NLTK (Natural Language Toolkit):** This is the first platform for building Python programs to work with human language data
  pip install nltk
- After installing NLTK, you also need to download some datasets and resources.
  import nltk
  nltk.download('stopwords')
  nltk.download('punkt')

nltk.download('wordnet')

Navigate to Application Directory:

- Open a command prompt or terminal.
- Use the `cd` command to navigate to the directory where the application code is located.

Run the Application:

- Once in the application directory, run the following command to start the application:

  python app.py

Get the application form:

- Open a web browser and navigate to the specified URL where the application is installed (e.g., http://localhost:5000).
- You can then access the Sentiment Analysis System and perform sentiment analysis on the textual data.

Provide Text for Analysis:

- Enter the text you want to analyze into the provided input field.
- Click on the "Analyze Sentiment" button to initiate the sentiment analysis process.

Check out the survey results:

- Once the analysis is complete, the application will display the sentiment analysis results, indicating whether the text is positive or negative.

Close the Application:

- To quit the application, press `Ctrl + C` at the command prompt or terminal window where the application is running.
- Confirm that the application process has been completed.

6.4 Operating Manual

The Sentiment Analysis System is a user-friendly web application designed to analyze the sentiment of textual data. This User's Manual provides step-by-step instructions so that you can perform all functions of the application.

To get the application:

- Open a web browser and enter the URL where the application is installed (e.g., http://localhost:5000).

Conducting a sentiment analysis:

- After the application loads, you will see a home page with a text input field and an "analysis" button.
- Enter the text you want to analyze into the provided input field.
- Click on the "Analyze" button to initiate the sentiment analysis process.

Looking analysis results:

- Once the analysis is complete, the application displays the results of the sentiment analysis on the screen.
- The results will indicate the quality or poor quality of the data analyzed.

Analysis results

Perform with some random text

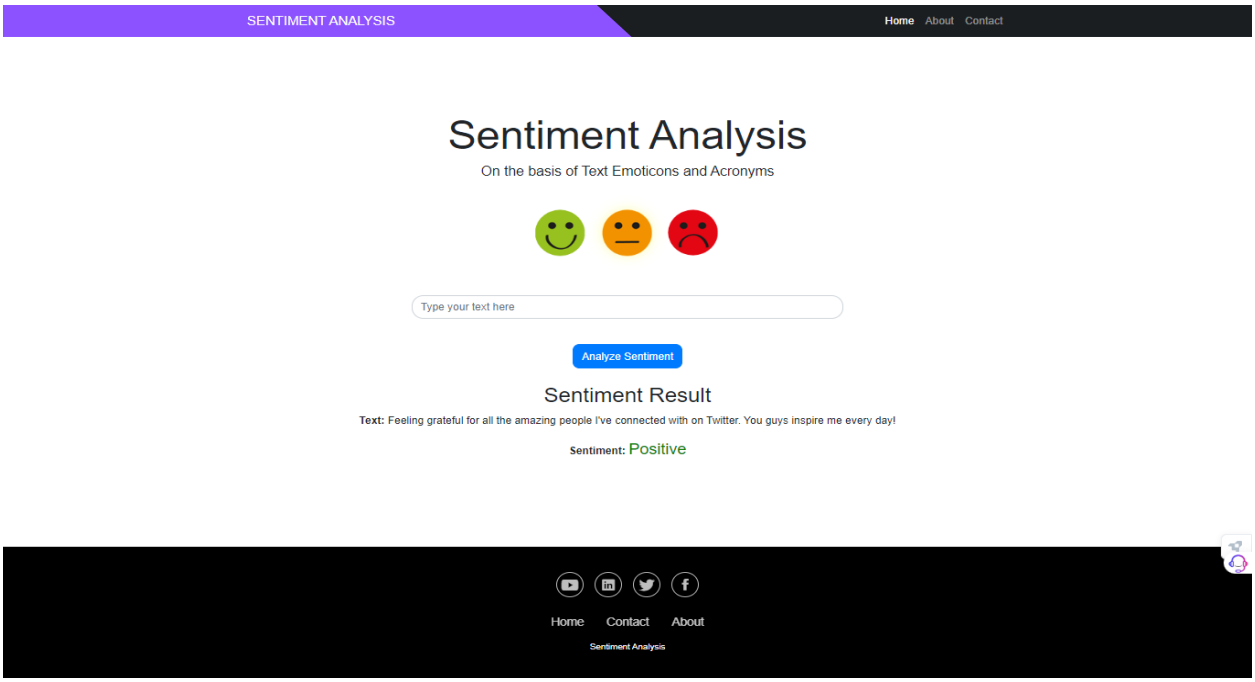

Figure 12 Text Analysis Result

Perform with some Text & Emoticons

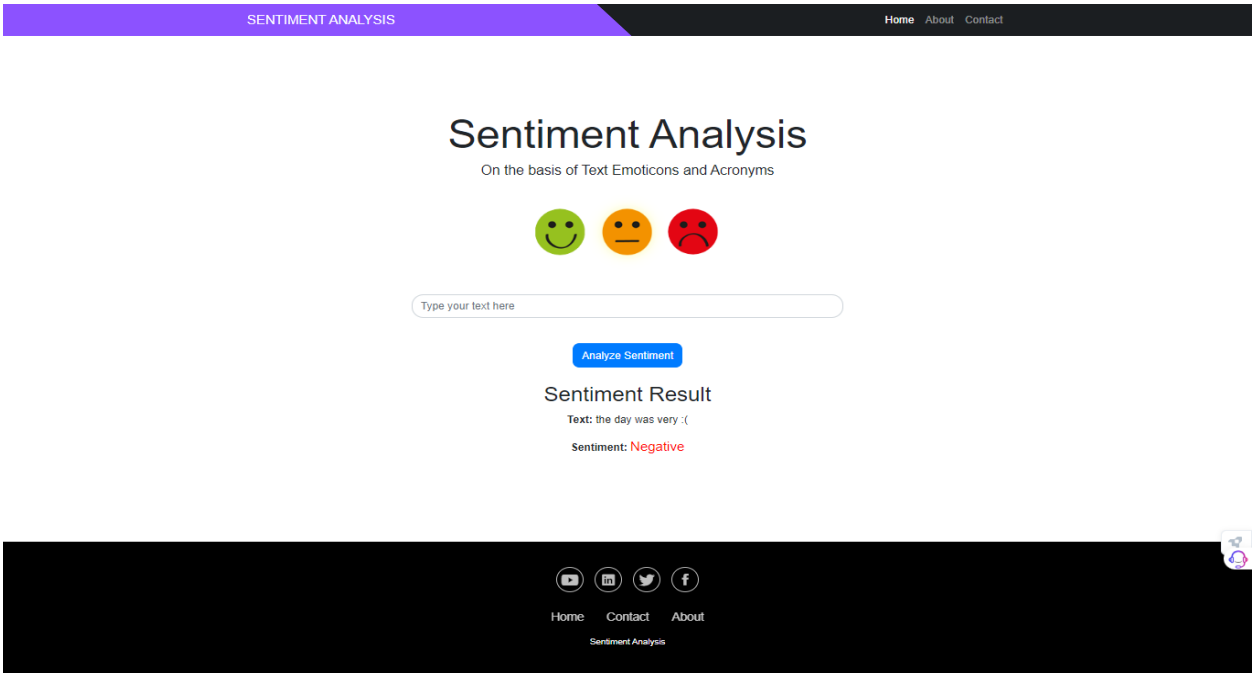

Figure 13 Analysis Result of Text with Emoticons

Perform with Textual data containing Emoticons & Acronyms

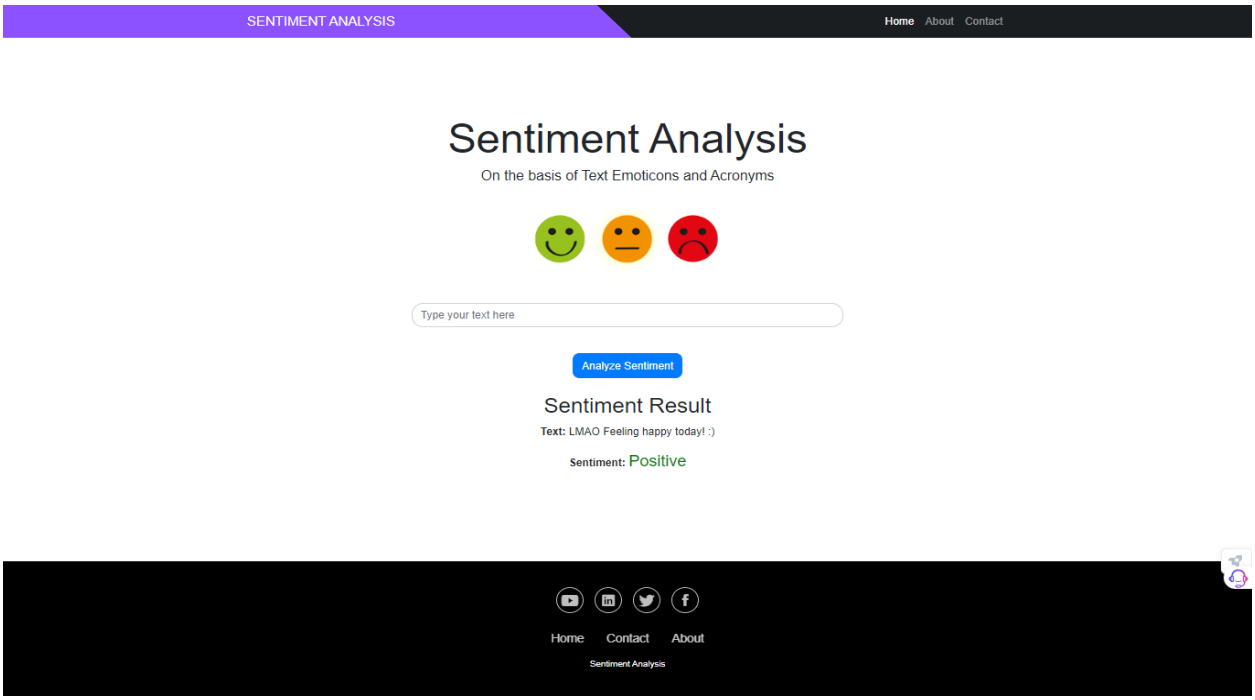

Figure 14 Text Analysis with Emoticons & Acronyms Result