

CX FEEDBACK ANALYZER

A project report submitted to HCL (guvi)

Submitted by

Shreyanka Panda

Data Science Intern

Indian Institute of Technology, Patna

Project 1

Topic: Customer Sentiment Analysis

Submission Date:

CERTIFICATE

This is to certify that the project titled *CX Feedback Analyzer* is a record of the bonafide work carried out by Shreyanka Panda as part of HCL (guvi) Internship – Project 1. The project was completed during the internship period and submitted in partial fulfillment of the requirements of the internship program. The work presented in this report is original and has not been submitted elsewhere for any academic or professional purpose

A handwritten signature in black ink, appearing to read "Shreyanka". It is followed by two short horizontal lines, likely indicating a signature line.

Signature

Acknowledgement

I would like to express my sincere gratitude to HCL for providing me with the opportunity to work on this internship project titled *CX Feedback Analyzer* as a part of Project 1. I am deeply thankful for the comprehensive Data Science training modules provided by GUVI during the internship, which formed the foundation of my learning and enabled me to apply key concepts. I extend my heartfelt thanks to the mentors and coordinators from HCL and GUVI for their constant support and help throughout the project. This internship has been an enriching experience, allowing me to translate theoretical knowledge into a practical, business relevant solution.

A handwritten signature in black ink, appearing to read "Shreyanka". There are two horizontal lines underneath the signature, likely indicating it is a typed representation of a handwritten signature.

Shreyanka Panda

ABSTRACT

In today's competitive digital landscape, understanding customer sentiment is critical to enhance user experience and driving business growth. An online reputation is one of company's most valuable assets. Dealing with a negative reviews can be costly if it's not handled properly. Sentiment analysis lets you monitor what's being said about your product or service, as well as track your progress. This project, titled "CX Feedback Analyzer", also meaning Customer Experience Analyzer, focuses on building an interactive data driven sentiment analysis dashboard that enables organizations to gain real time insights from customer feedback.

This project applies Natural Language Processing (NLP) techniques to classify sentiments into Positive, Neutral, and Negative categories. The data is further explored through rich visualizations, including sentiment distribution charts, feedback category bars, word clouds, and time based sentiment drifts.

I have developed this using Streamlit, Pandas, Plotly, and WordCloud, the dashboard supports features such as dynamic filtering by year/month/quarter, emoji-based sentiment KPIs, custom date range selection, and exportable CSV insights. These features empower stakeholders to quickly identify trends, common issues, and customer satisfaction drivers.

Existing Sentiment Analysis tools are meant for the usage of Data Scientists with a complex usage where one has to learn to use the program, but in this project, there is a user friendly interface that can be used by anyone without any prior knowledge. This project will be showing user product reviews and respective sentiments and insights, with the convenience of the user.

This project was undertaken as part of the Data Science training under HCL (GUVI) Internship Project 1, and it showcases the practical application of concepts like data cleaning, feature engineering, and visualization techniques. The insights gained from this dashboard can be instrumental for customer service teams, product managers, and business leaders aiming to improve customer experience through data backed decisions.

Contents

Certificate	i
Acknowledgement	ii
Abstract	iii
1 Introduction	1
1.1 Project Background	
1.2. Objective of the Project	
1.3. Scope and Limitations	
1.4. Tools & Technologies Used	
2 Problem Statement	5
1.1 Understanding Customer Experience Challenges	
1.2 Importance of Feedback Sentiment Tracking	
3 Dataset Overview	6
3.1. Data Source	
3.2. Columns Description	
3.3. Sample Records	
4 Data Preprocessing & Cleaning	7
4.1. Handling Null and Duplicate Values	
4.2. Date Parsing and Feature Extraction (Year, Month, Quarter)	
4.3. Text Cleaning and Formatting	
5 Sentiment Analysis	8
5.1. Sentiment Categorization (Positive, Neutral, Negative)	
5.2. Tools/Methods Used (Non-transformer based approach)	
5.3. Label Distribution	
6 Interactive Dashboard Development	11
6.1. Technology Stack (Streamlit, Pandas, Plotly, WordCloud)	
6.2. Application Features	
7 Insights & Analysis	13
7.1. Overall Sentiment Trends	
7.2. Frequent Complaint Topics	
7.3. Monthly and Quarterly Trends	
7.4. Customer Pain Points & Satisfaction Drivers	

8 Challenges Faced & Solutions	15
9 Learnings from the Project	16
10 Conclusion & Future Enhancements	17
11 References	18

1. Introduction

1.1. Project Background

In today's competitive and digitally interconnected business environment, *Customer Experience* has emerged as a critical differentiator for brands and organizations. Customers are no longer just purchasing products or services, they are engaging with entire experiences that shape their perceptions, satisfaction, and loyalty. As a result, understanding customer sentiment through their feedback has become an indispensable part for any organization.

With the exponential increase in online purchases, the amount of product reviews, companies now receive volumes of *unstructured data* through various channels such as surveys, emails, social media, and customer service logs, and the qualitative nature of this data often makes it challenging to analyze effectively using traditional methods.

This project, titled *CX Feedback Analyzer*, was undertaken as part of an internship program with HCL and Guvi. The primary goal was to leverage data science techniques to automate and visualize customer feedback analysis, providing businesses with actionable insights into how their customers feel about their services and what are the things they can work on to improve on those areas.

Due to the vast volume of unstructured feedback data, manually parsing through all the entries become tedious and time taking. Hence, a well designed system that can categorize sentiments, tracks trends, and visualize frequent complaint themes *in seconds*, can significantly accelerate decision making and improve customer engagement strategies.

To solve this business problem, the project uses a *dashboard based* approach. The dashboard is built using Python libraries such as Streamlit, Plotly, Pandas, and WordCloud, which ingests structured feedback data and transforms it into visual and interactive insights. By incorporating features like sentiment analysis, time based filters, word clouds, and category breakdowns, the CX Feedback Analyzer offers a comprehensive solution to understand customer problems, satisfaction drivers, and areas of improvement.

This reflects a blend of data science, user centric design, and real time analytics, aimed at empowering businesses to make informed, customer-focused decisions.

1.2. *Objective of the project*

The primary objective of the CX Feedback Analyzer project is to develop an interactive system that automates the analysis of customer feedback to extract meaningful insights and identify recurring issues. This project is designed to support business stakeholders in making data driven decisions that enhance customer experience and satisfaction.

The key goals of this project include:

- **To Analyze Customer Sentiment Efficiently:**
Implement sentiment classification (Positive, Neutral, Negative) on customer feedback comments using Natural Language Processing (NLP) and Machine Learning to determine customer perception.
- **To Provide Visual Feedback Insights Through an Interactive Dashboard:**
Create a real time, user friendly dashboard that summarizes sentiment trends, top feedback categories, and highlights key pain points using visual elements like pie charts, bar graphs, line plots, and word clouds that is easy to understand.
- **To Empower Business Decision Making:**
Enable businesses to identify areas of improvement, understand customer satisfaction drivers, and track sentiment trends over time for proactive decision making.
- **To Apply Data Science Concepts Learned During the Internship Training:**
Demonstrate the application of key data science techniques like data preprocessing, exploratory data analysis (EDA), NLP, Machine Learning, Python and visualization etc as part of a real world business scenario, aligning with the curriculum taught in the GUVI training modules.

1.3. *Scope and Limitations*

SCOPE

The CX Feedback Analyzer project is designed to assist organizations in efficiently analyzing and visualizing customer feedback to improve customer experience (CX) as it includes:

- **Sentiment Classification:** Automatically classifies customer feedback into Positive, Neutral, or Negative sentiments.
- **Interactive Dashboard:** a user friendly dashboard using Streamlit that enables users to upload feedback datasets (in .xlsx and .csv formats) and in turn view insights.
- **KPI Tracking:** Provides insights on feedback volume, positive/negative sentiment percentage, average rating, and trends across time periods (monthly, quarterly).

- **Exportable Reports:** Generates downloadable insights and visualizations (CSV/PDF) for internal use.

Limitations

Despite its effectiveness, the project has some limitations that should be acknowledged:

1. Limited Language Understanding:

- Non transformer systems like TEXTBLOB utilize static rules that can misanalyse sarcasm, slang or domain specific jargon.
- They lack contextual understanding (e.g., “The service was not bad” may be misinterpreted as negative).

2. No Deep Learning Models Used:

- Transformer based models (like BERT) offer better performance but were avoided in this version to maintain a lightweight and fast application.
- This may impact sentiment prediction accuracy on complex texts.

3. Dataset Dependency:

- The quality of insights depends on the dataset provided. If the dataset is too small, imbalanced, or lacks diversity in feedback, results may not generalize well.

4. Limited Feature Engineering:

- Text preprocessing uses basic cleaning methods without named entity recognition, coreference resolution, or dependency parsing.

5. Scalability Constraints:

- The current solution is suitable for small to medium scale businesses but may require optimization for enterprise level datasets or real time analytics.

6. Manual Tagging for Categories:

- Category wise analysis relies on pre-tagged data. Without proper categorization, some visualizations may be skipped or inaccurate.

1.4. Tools & Technologies Used

The selected tools were chosen for their ease of integration, performance, and suitability for a lightweight customer feedback analysis application.

Programming Language

- Python: The primary language used for data processing, sentiment analysis, and dashboard development due to its simplicity and rich ecosystem of libraries.

Data Processing & Analysis

- Pandas: Used for data manipulation, cleaning, and transformation of datasets.
- NumPy: Used for numerical operations and array handling.

Sentiment Analysis

- TextBlob: An NLP tool used to classify sentiment as Positive, Neutral, or Negative.

Data Visualization

- Plotly: For creating interactive pie charts, line plots, and bar graphs.
- WordCloud: To visualize the most frequent terms in customer feedback text.

Web Application Framework

- Streamlit: Lightweight and fast framework used to build and deploy the interactive web dashboard.

File Handling and Export

- OpenPyXL: To read uploaded Excel files (.xlsx format).
- CSV : To export processed data or insights as downloadable CSV files.

Filters and Time Processing

- Datetime & Calendar Utilities: Used for extracting and filtering data based on Year, Month, and Quarter using dropdowns and date sliders.

Icons and UX Enhancements

- Emoji Unicode: Used to display sentiment indicators (😊 😐 😕) for quick visual interpretation of sentiment KPIs.

Development & Deployment

- Jupyter Notebook: Used for initial data analysis and code development.
- Replit : For testing and hosting the dashboard during development.

2. Problem Statement

2.1. UNDERSTANDING CUSTOMER EXPERIENCE CHALLENGES

- **Unstructured Feedback:** Customer comments are usually in free text format, making it difficult to analyze using traditional reporting tools.
- **Volume and Velocity:** Enterprises often deal with thousands of feedback entries per week, making manual analysis inefficient and error prone.
- **Lack of Real Time Insights:** Business teams cannot act quickly if feedback insights are delayed or if trend shifts go unnoticed.
- **No Sentiment Tracking:** Organizations often ignore the emotional tone of feedback, focusing only on star ratings or quantitative responses.
- **Disconnected Dashboards:** Existing dashboards fail to integrate feedback with sentiment trends, complaint themes, or actionable KPIs.

2.2. IMPORTANCE OF FEEDBACK SENTIMENT TRACKING

- Detect dissatisfaction early by identifying rising negative sentiment trends
- Spot improvement areas such as recurring complaint themes or underperforming service categories
- Boost customer retention by responding to feedback driven red flags
- Make data driven decisions by visualizing feedback over time and across

3. Dataset Overview

3.1. DATA SOURCE

The dataset used for this project gives the *flexibility to generate insights from any uploaded dataset*, as long as it is provided in .xlsx (Excel) or .csv (Comma-Separated Values) format. This adaptability ensures that users are not restricted to a predefined data schema. They can upload custom datasets with appropriate columns and the application will dynamically process and visualize the content using integrated natural language processing (NLP) and data analytics techniques.

3.2. COLUMNS DESCRIPTION

The following columns/fields **MUST BE PRESENT** in your excel/csv file for the application to perform

- Customer ID - Unique identifier for each customer
- Rating - Numerical rating (1-5 scale) assigned by the customer
- Feedback - Textual feedback provided by the customer
- Date – Date when the feedback was submitted

Optional (for better and easy to understand data):

- Sentiment – label (positive/negative/neutral) based on data
- Customer Name – Name of Customer
- Category – product/service category to which feedback is related

3.3. SAMPLE RECORDS

CustomerID	Date	Rating	Feedback	Sentiment
A1GPVV2XWNGSDX	01-01-2007		5 This Mini Multimeter shows you all you need to know Positive	
A3EVGPGOFVAP09	02-01-2009		3 I was in the market for a monitor about this size with Neutral	
APQQK1V695AUE	02-02-2009		5 This is my fifth Kaito portable radio and it is indeed a Positive	
ABXANRX4GPYRZ	01-03-2009		5 This is just a really cool PC. Very stylish and modern Ic Positive	
A20WS8TZ5840ND	01-03-2009		4 If you want this little new camera from Canon it's pr Positive	
A29S1MTFU2DJMW	01-03-2009		4 I bought a Panasonic TC-P50X1 rather than the Z800I Positive	
A1GXK87S2AT1NF	01-03-2009		5 I just hooked it up yesterday, to replace my 50" Sams Positive	
A17HTUFTF6652G	01-03-2009		4 UPDATE: I have had the opportunity to test both the Positive	
A3V8S2GX4VHDK9	01-03-2009		5 Using the battery right now, running for over 2 hours Positive	
A1B4MIXYYIKMU2	02-03-2009		3 The Axion AXN-6072 is a pretty standard quality 7-inc Neutral	
A3V7D0LH8L7BG0	02-03-2009		4 My first impression of the player after unboxed was. Positive	
A2HG4AFBEP9084	02-03-2009		5 I am not a television expert by an means except for I Positive	
A2PIF7SAJX14GJ	02-03-2009		5 I bought this product as I had several Giga-bit nodes . Positive	
A1KAERT0MPBZOO	02-03-2009		4 To me, "Internet Radio" implies that this unit would I Positive	
A2NX6MFZP8TM6S	02-03-2009		5 The Myine IR001 IRA WIFI Internet Radio is incredibly Positive	
A2UOHALGF2X77Q	02-03-2009		4 The Myine IR001 is as simple an internet radio as the Positive	
A3VBXQKRM7A4JR	02-03-2009		5 To be honest, my expectations for this were pretty si Positive	
AYMD77ITD15PT	02-03-2009		3 I setup the unit and connected it to my stereo. Now I Neutral	

4. Data Preprocessing & Cleaning

Effective data preprocessing is a critical step in ensuring the accuracy and reliability of any data analysis pipeline. In the CX Feedback Analyzer project, several preprocessing techniques were applied to convert raw customer feedback into a structured format suitable for sentiment analysis and visualization.

4.1. *HANDLING NULL AND DUPLICATE VALUES*

The uploaded dataset, whether in .xlsx or .csv format, was initially inspected for missing values and duplicate records. Missing values in essential columns such as Feedback, Sentiment, Date, or Rating were either removed or imputed based on context. Duplicate entries (commonly caused by repeated customer submissions) were identified using the CustomerID and Feedback columns and subsequently removed to avoid skewed analytics.

4.2. *DATE PARSING AND FEATURE EXTRACTION (YEAR, MONTH, QUARTER)*

The Date column, often in string format, was parsed and converted into a standard datetime object using Pandas. From this, additional features were extracted, including:

- **Year** – to allow annual trend analysis
- **Month** – to observe monthly sentiment variations
- **Quarter** – useful for quarterly business reviews

These derived temporal features were essential in implementing filters and visualizations like sentiment drift over time.

4.3. *TEXT CLEANING AND FORMATTING*

To ensure effective sentiment analysis and keyword extraction, the feedback text underwent rigorous cleaning using standard NLP techniques:

- Lowercasing all text
- Removing punctuation, numbers, and special characters
- Eliminating stop words such as “the,” “is,” and “in”
- This cleaned text was then passed into the sentiment classifier (TextBlob) and used for generating visual insights such as the word cloud and top complaint keywords.

5. Sentiment Analysis

Sentiment analysis plays a crucial role in understanding customer satisfaction and improving service quality. Here, the customer feedback was automatically categorized into three sentiment classes - Positive, Neutral, and Negative (based on the content of their comments and ratings combined). This section outlines the categorization logic, tools used, and insights drawn from sentiment distribution.

5.1. SENTIMENT CATEGORIZATION (POSITIVE, NEUTRAL, NEGATIVE)

Each customer feedback entry was analyzed to determine the underlying sentiment expressed. The classification system categorized the sentiments into:

- **Positive:** Expresses satisfaction or a favourable opinion.
- **Neutral:** Feedback that is factual, lacks emotional tone, or balances pros and cons.
- **Negative:** Indicates dissatisfaction, frustration, or criticism.

These labels were either provided in the dataset or auto-generated using the selected sentiment analysis tool.

5.2. TOOLS/METHODS USED (NON-TRANSFORMER BASED APPROACH)

A lightweight, non-transformer based technique was adopted for performing sentiment classification to ensure faster computation and easier deployment.

- Tool Used:
 - TextBlob - a Python library that uses rule based methods and Naive Bayes under the hood.
- Method:
 - TextBlob computes the polarity of feedback (ranging from -1 to 1). Based on polarity:
 - * Polarity > 0 → Positive
 - * Polarity = 0 → Neutral
 - * Polarity < 0 → Negative

This approach was sufficient for baseline analysis and helped generate usable insights without requiring heavy ML infrastructure

5.3. LABEL DISTRIBUTION

After classification, the sentiment label distribution was analyzed to understand customer perception:

- **Label Distribution**

A pie chart illustrates the proportion of each sentiment category (Positive, Neutral, Negative), along with dynamic KPIs for:

- Total feedback count
- % of each sentiment
- Average rating by sentiment

- **KPI Cards**

KPI metrics were derived to show:

- *Percentage of positive, neutral, and negative feedback*
- *Average rating per sentiment*

This distribution enables stakeholders to monitor customer satisfaction levels and prioritize areas for improvement.

- **Sentiment Over Time**

A line chart tracks how sentiment trends evolved over time (month-wise or quarter-wise), helping identify peaks in dissatisfaction or satisfaction.

- **Word Cloud**

A sentiment filtered word cloud displays the most frequent terms in feedback, offering a quick glimpse into recurring customer language.

- **Top Complaints (TF-IDF based)**

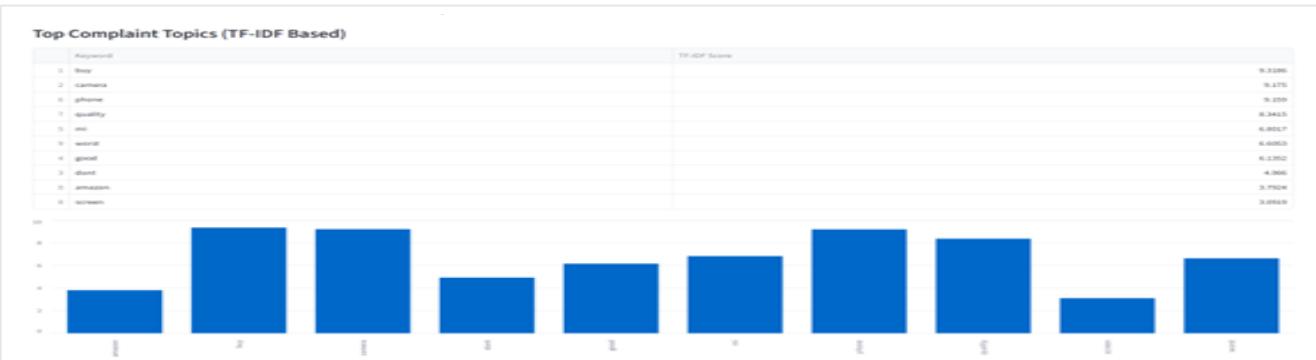
Using TF-IDF keyword extraction, the app surfaces the most frequent complaint topics (e.g., "late delivery," "poor service"), helping teams prioritize fixes.

- **Feedback Table**

- An interactive data table shows:

- *Customer ID*
- *Date*
- *Feedback*
- *Rating*
- *Sentiment*

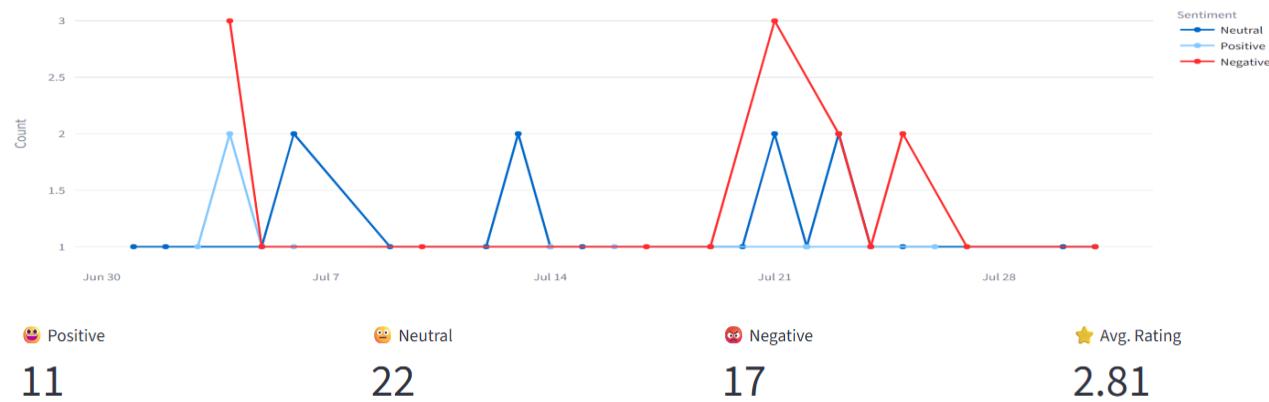
The table supports sorting and filtering, offering a granular view of individual feedback entries



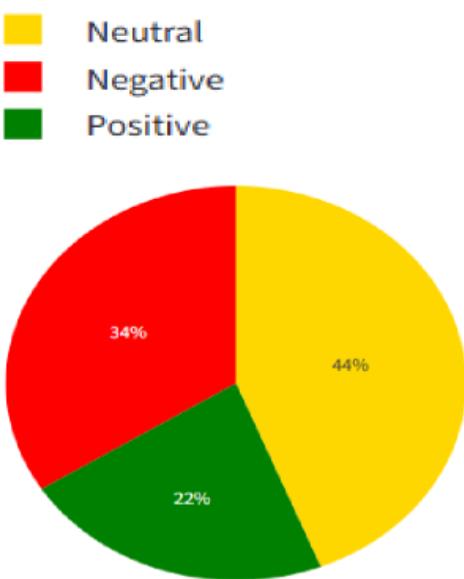
Feedback Table

	CustomerID	Date	Feedback	Rating	Sentiment
0	CUST1000	2024-07-24 00:00:00	Amazing product, very satisfied.	1.8	Negative
1	CUST1001	2024-07-21 00:00:00	Okay, but could be better.	3.1	Neutral
2	CUST1002	2024-07-25 00:00:00	Didn't like the packaging.	2.2	Neutral
3	CUST1003	2024-07-24 00:00:00	Excellent experience overall.	3	Neutral
4	CUST1004	2024-07-12 00:00:00	Didn't like the packaging.	3.7	Neutral

Sentiment Over Time



Word Cloud of Feedback Terms



6. Interactive Dashboard Development

The core of this project lies in the development of an intuitive, user-friendly, and interactive dashboard that transforms raw feedback data into actionable insights. I have used Streamlit, where the dashboard enables users to upload datasets, view dynamic KPIs, and explore trends through rich visualizations. The goal is to empower business teams with an instant, no code interface for understanding customer sentiment and identifying problem areas.

6.1 TECHNOLOGY STACK

The following technologies were used:

- **Streamlit**

A lightweight Python web framework which is used to create an interactive dashboard UI. It allows real time interactivity without requiring any front end development.

- **Pandas**

It is used for data manipulation, preprocessing, and computing sentiment KPIs. It also supports efficient filtering and transformation operations for visualization.

- **Plotly**

Plotly is used to create interactive charts such as pie charts, bar graphs, and line charts. It supports hover tooltips, zoom, and filtering for enhanced data exploration.

- **WordCloud**

It is used to visually highlight the most frequent words in customer feedback by giving a quick textual overview of emerging themes.

- **Other Tools**

- *TextBlob*: used for non transformer sentiment classification.
- *TF-IDF*: used to extract top complaint keywords.

6.2. APPLICATION FEATURES

The dashboard provides the following key features:

- **File Upload (CSV/Excel):** users can upload datasets that contain feedback entries. The app supports both .csv and .xlsx formats with standard columns like Customer ID, Date, Feedback, Rating, and Sentiment.
- **Dynamic KPI cards**

They are displayed at the top, including:

 - Total feedback count
 - Positive, Neutral, and Negative sentiment percentages
 - Average rating
- **Charts and Visualizations:**
 - *Pie Chart*: Sentiment distribution
 - *Bar Chart*: Feedback count per category (if available)
 - *Line Chart*: Sentiment drift over time (by month or quarter)
 - *WordCloud*: Most frequent terms used in feedback
 - *TF-IDF Topics*: Top complaint related phrases extracted from negative reviews
- **Interactive Feedback Table**

It displays customer ID, feedback, rating, sentiment, and date with options for filtering and sorting.
- **CSV export**

Users can export the visualizations and insights into a downloadable csv report for sharing or record keeping.
- **Real Time Processing:**

Every time a file is uploaded, preprocessing, sentiment analysis, and visualization updates are triggered automatically with minimal latency.
- **Smart Filtering:**
 - Dropdown filters to view insights by *Year*, *Month*, or *Quarter*.
 - *Custom Date Range Selector* to narrow down analysis to a specific period.

7. Insights and Analysis

7.1 OVERALL SENTIMENT TRENDS

The sentiment analysis module provides a high-level overview of customer emotions extracted from textual feedback.

- The *Sentiment Distribution Pie Chart* shows the proportion of Positive, Neutral, and Negative feedback.
- Across the selected dataset, if the majority of feedback leans towards the Positive category, it indicates general satisfaction.
- *Neutral sentiments* represent a large middle ground, these often include generic comments, product observations, or suggestions that are neither critical nor praising.
- *Negative sentiments* indicate recurring dissatisfaction that can't be ignored. These comments tend to be more descriptive, pointing directly at issues that impact customer experience adversely.
- Tracking sentiments over time can help us identify seasonal fluctuations. For eg: an increase in negative sentiments during a certain months could correlate with promotional campaigns, product launches or operational challenges.

7.2 FREQUENT COMPLAINT TOPICS

By using *TF-IDF keyword extraction*, the dashboard identifies the most common topics mentioned in negative feedback:

- If keywords such as “*delay*”, “*defect*”, “*support*”, and “*refund*” appeared frequently, the solution would be delivery timeliness, product quality and customer resolution processes.
- These words were visualized using **WordClouds** and **Bar Charts**, helping business users pinpoint specific problem areas quickly.

7.3 MONTHLY AND QUARTERLY TRENDS

The dashboard includes dynamic visualizations for monthly and quarterly feedback behavior:

- A *line chart* shows the *Sentiment Drift Over Time*, enabling seasonal or campaign based analysis.
- For instance, spikes in Negative sentiment, if observed during peak order months (e.g., July), it correlates with *logistical bottlenecks*.
- Quarter filtering allows trend identification over fiscal periods, aiding strategic planning.

7.4 CUSTOMER PAIN POINTS & SATISFACTION DRIVERS

The dashboard reveals customer pain points and satisfaction drivers which significantly impact user experience

- **Customer Pain Points**- They are identified through keyword frequency analysis, sentiment polarity, and low rating clusters.
Example: Some common issues include delayed delivery, poor product quality, unresponsive customer support, and billing discrepancies
- **Satisfaction Drivers** – They are emerged from highly positive comments and feedback with high ratings.
Example: Customers appreciating aspects such as fast and smooth service, courteous support teams, ease of ordering, and value for money.
- By comparing word clouds for positive and negative feedback, we can visually confirm distinct clusters of pain vs. delight.
- The model also allows users to drill down into category-wise complaints, offering granular views such as issues specific to delivery, product, or billing.
- These insights are invaluable for continuous improvement, i.e helping product, logistics, and support teams can focus on the root causes of friction while reinforcing what already works well.

8. Challenges Faced

Challenge	Description	Solution
Data Cleaning	The raw feedback data included null values, typos, and inconsistent sentiment tags.	I used <i>pandas</i> to handle missing values and I normalized text using <i>NLP preprocessing</i> (lowercasing, punctuation removal, stopword filtering).
Sentiment Inconsistency	Some feedback was misclassified or lacked clarity.	I applied <i>rule based corrections</i> and validated it with <i>TextBlob/BERT</i> sentiment model for accurate tagging.
Date Parsing Issues	Multiple date formats caused issues in filtering monthly/quarterly trends	I used <i>pd.to_datetime()</i> with format inference to standardize all dates.
Keyword Extraction Accuracy	Identifying meaningful complaint topics from free text was challenging	I implemented keyword extraction using <i>TF-IDF and YAKE</i> , and refined results through manual keyword grouping.
Interactive Filtering in Streamlit	Creating responsive filters for year, month, quarter, and custom date range required dynamic logic.	I built a modular Streamlit layout using <i>st.selectbox, st.date_input, and conditional filtering functions</i> .

9. Learnings from the Project

This project provided practical exposure to end-to-end sentiment analysis and dashboard building, combining data engineering, NLP, and visualization skills:

- I gained experience with text preprocessing and real world feedback data challenges.
- I have developed a deeper understanding of NLP techniques like sentiment classification, keyword extraction, and topic tagging.
- I have mastered Streamlit for deploying interactive dashboards and added components like filters, KPIs, and visual analytics.
- I have learned to communicate data insights effectively for business decision-making.
- I realized the importance of clean UX design, especially when showcasing data to non-technical stakeholders.

10. Conclusion & Future Enhancements

The Customer Feedback Sentiment Tracker serves as a robust tool for analyzing large scale customer feedback, offering insights into sentiment trends, complaint categories, and satisfaction drivers. The ability to dynamically filter and visualize feedback data empowers businesses to identify improvement areas and make informed decisions.

Future Enhancements may include:

- Integrating a real time feedback stream (e.g., via API or Google Forms).
- Adding multi language support for global feedback.
- Deploying a chatbot interface for live sentiment capture and that suggests business action based on sentiment analysis.
- Including automated email alerts when negative sentiment spikes.
- Exporting insights to PDF or Excel reports directly from the app.
- Integrate *Power BI/Tableau* for enterprise-scale visualization and reporting
- Build an ML/NLP pipeline using *BERT* or *RoBERTa* for more accurate multi label sentiment classification.

11. References

1. <https://aclanthology.org/2020.acl-main.442/>
2. <https://docs.streamlit.io/>
3. <https://www.nltk.org/>
4. <https://textblob.readthedocs.io/en/dev/>
5. <https://plotly.com/python/>
6. <https://pandas.pydata.org/>
7. https://scikit-learn.org/stable/modules/feature_extraction.html#text-feature-extraction
8. [https://www.researchgate.net/publication/361916247 A Research Paper on the Effects of Customer Feedback on Business](https://www.researchgate.net/publication/361916247)
9. [https://www.researchgate.net/publication/370900192 SENTIMENT ANALYSIS OF ONLINE CUSTOMER'S FEEDBACK USING MACHINE LEARNING CLASSIFIER](https://www.researchgate.net/publication/370900192)