

## CUSTOMER REVIEWS FOR ASPECT BASED SENTIMENT ANALYSIS USING MACHINE LEARNING

Sanika Dange\*<sup>1</sup>, Sakshi Dhumake\*<sup>2</sup>, Shruti Khade\*<sup>3</sup>, Kumud Patil\*<sup>4</sup>,  
Asst. Prof. Komal Patil\*<sup>5</sup>

\*<sup>1,2,3,4,5</sup>Department Of Computer Science And Engineering Sharad Institute Of Technology College Of  
Engineering, Ichalkaranji, Maharashtra, India.

### ABSTRACT

Sentiment analysis of product reviews on e-commerce websites helps to identify customer preferences. Aspect-based sentiment analysis (ABSA) goes a step further by pinpointing specific aspects of a product and analyzing the sentiment associated with each, offering a more granular understanding of customer attitudes. This method improves the traditional rating-based recommendation system by focusing on product aspects. To automate ABSA, a labeled dataset is necessary for training supervised machine learning models. However, their availability is limited due to the manual effort required to create such datasets. This annotated dataset, which contains customer reviews of the Apple iPhone 11, has been manually labeled with predefined aspect categories and their corresponding sentiments like positive, Negative, and Neutral. The accuracy of this dataset has been validated using several state-of-the-art machine learning techniques, including Naive Bayes, Support Vector Machine, Logistic Regression, Random Forest, K-Nearest Neighbor, and a Multi-Layer Perceptron (MLP) model built with the Keras API. These models enable the transition from a conventional rating-based approach to a more precise, aspect-driven analysis, leading to enhanced product recommendations based on customer reviews.

**Keywords:** Product Recommendations, E- Commerce Reviews, Machine Learning Model, Sentiment Classification.

### I. INTRODUCTION

This project, 'Product Sentiment Analysis', is developed to analyze product reviews from various e-commerce platforms like Amazon, Flipkart, Ajo, and Meesho. The tool utilizes Natural Language Processing (NLP) techniques to gauge the overall sentiment of product reviews and provide a buy recommendation based on the sentiment analysis. The sentiment analysis is performed using two popular NLP libraries: VADER (Valence Aware Dictionary and sentiment Reasoner) and Text Blob which analyses sentiment in text. In this project, we propose a comprehensive approach to ABSA using state-of-the-art Machine Learning (ML) techniques. For understanding the customer feedback on an entity, sentiment analysis is becoming an augmenting tool for any organization. Sentiment analysis involves examining online conversations like tweets, blog posts, or comments about particular services or topics and segregating the users' opinions (positive, negative, and neutral) which allows businesses to identify customer sentiment towards the products. Customer feedback in the form of user reviews provides an account of a user's hands-on experience with a product. Many e-commerce users rely on trust in these reviews more than other forms of advertising when making a purchase decision. It has become obvious to analyze people's opinions. To extract such granular insights, Aspect-Based Sentiment Analysis (ABSA) has been developed. ABSA goes beyond overall sentiment detection by identifying specific product aspects (e.g., design, price, durability) mentioned in reviews and analyzing the sentiment associated with each of these aspects.

### II. LITERATURE REVIEW

[1].Lella Kranthi Kumar, Venkata Nagarjun Thatha, Pamula Udayaraju, D. Siri, Uday Kiran, B. N. Jagadesh, Ramesh Vatambeti "Analyzing Sentiment On the Amazon Website"[1] focuses on using advanced machine learning techniques to analyze public sentiment from Amazon reviews. The goal is to leverage a unique sentiment analysis model to classify reviews into positive, negative, or neutral categories, offering insights into customer satisfaction and product perception.

[2].Ruba Obiedat, Raneem Qaddoura, Ala M. Al-Zoubi, Osama Harfoushi, Moath Alreel, "Sentiment Analysis Of Customer Reviews Using Machine Learning "focuses on tackling the challenge of sentiment analysis in datasets

where the distribution of positive, negative, and neutral reviews is imbalanced. Imbalanced data is a common problem in sentiment analysis, especially when the majority of the reviews tend to be neutral or positive, with fewer negative ones. This imbalance can negatively impact the performance of traditional machine learning models, which may favor the majority class.

[3].Rae Yule Kim, "Online Reviews for Customer Sentiment Analysis"[3] focuses on analyzing customer sentiment from online reviews and identifying limitations in traditional metrics like review ratings and review volume. It proposes alternative metrics, such as **sentiment scores** and the use of **text mining techniques**, to better interpret customer feedback.[4].Dimple Chehal, Parul Gupta, and Payal Gulati, "Evaluating Annotated Dataset of Customer Reviews for Aspect-Based Sentiment Analysis"

[4] focuses on developing and evaluating a labeled dataset for **Aspect-Based Sentiment Analysis (ABSA)** of customer reviews, specifically for mobile phones. ABSA is an advanced form of sentiment analysis that identifies sentiments associated with specific aspects (features) of a product, allowing for a more detailed analysis of customer feedback

### III. METHODOLOGY

#### 1. Data Collection.

We will collect data from a popular e-commerce platform by collecting customer reviews of various products.

#### 2. Data Preprocessing

We will preprocess the data by removing stop words, stemming, and lemmatization to reduce words to their root forms and converting the text to lowercase. Remove unnecessary symbols (punctuation, special characters).

#### 3. Sentiment Analysis Algorithms

Implement the VADER (Valence Aware Dictionary and Sentiment Reasoner) and TextBlob to analyze the sentiment of customer or product reviews.

#### 4. TextBlob

Use TextBlob to get two key sentiment metrics polarity (ranging from -1 to 1) and subjectivity (ranging from 0 to 1). Polarity determines how positive/negative a text is, while subjectivity indicates whether a text is factual or opinion-based.

#### 5. Streamlit Application

The front end of the project is developed using Streamlit, an open-source Python library that makes it easy to build and share beautiful, custom web apps for machine learning and data science.

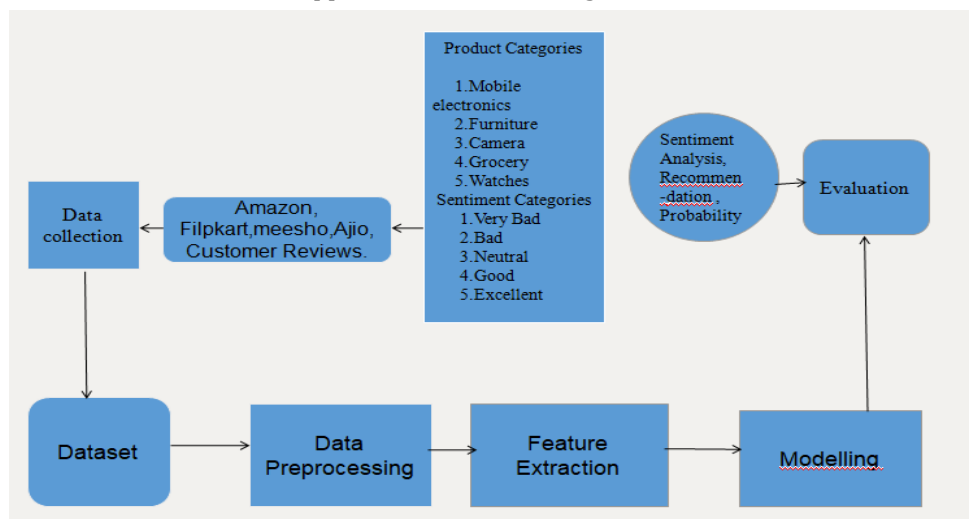


Fig 1. Data Flow Diagram

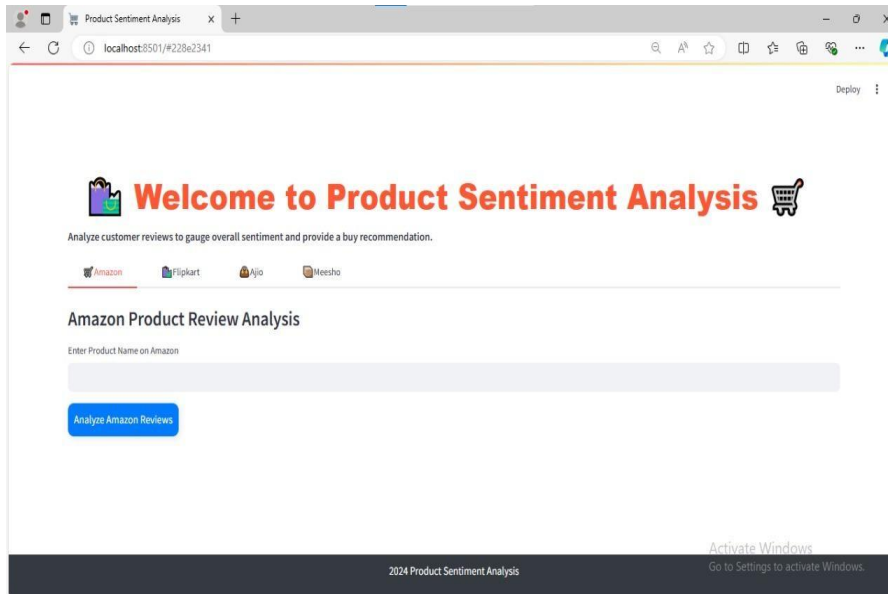
Data Flow Diagram shows actual flow of project. The data regarding multiple products available on different platforms is collected in dataset. The collected data is then preprocessed by using various ML algorithms. Next step is Feature Extraction i.e. conversion of textual data into numerical data. In modeling, ML model is created

& trained to make decisions based on data patterns. Next is evaluation of data. Sentiment Analysis, Recommendation & Probability finding is done under Evaluation.

#### IV. RESULTS AND DISCUSSION

'Product Sentiment Analysis', is developed to analyze product reviews from various e-commerce platforms like Amazon, Flipkart, Ajio, and Meesho. The tool utilizes Natural Language Processing (NLP) techniques to gauge the overall sentiment of product reviews and provide a buy recommendation based on the sentiment analysis.

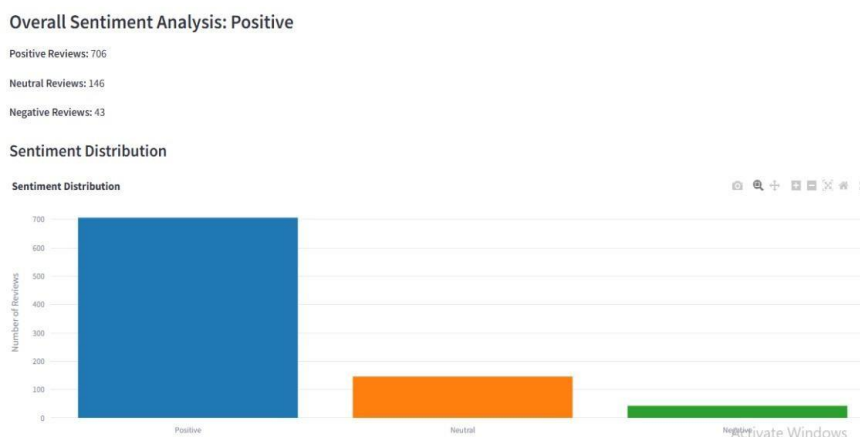
##### Screen shots of Project:



**Figure 2:** Product Sentiment Analysis Interface

This figure showcases a user interface for a "Product Sentiment Analysis" tool that analyzes customer reviews to determine overall sentiment and provide purchase recommendations. Users can enter an Amazon product name and click the "Analyze Amazon Reviews" button to initiate the analysis.

##### Overall Sentiment Analysis:



**Figure 3:** Sentiment Distribution

This figure displays the overall sentiment analysis of product reviews, showing a sentiment distribution in the form of a bar chart. The analysis categorizes the reviews into three sentiments: **Positive** (206 reviews), **Neutral** (146 reviews), and **Negative** (43 reviews). The bar chart visually represents the number of reviews for each sentiment, with the largest bar corresponding to positive sentiment, followed by neutral and negative sentiments in decreasing order.

**Sentiment Probability Distribution:**

**Summary of the Bar Chart:**

The bar chart above illustrates the sentiment distribution of the analyzed product reviews. As seen, a significant majority of the reviews are positive, indicating general customer satisfaction with the product. The neutral reviews suggest that while the product meets expectations, it may not exceed them. The proportion of negative reviews, although present, is relatively small, indicating that the majority of customers did not have major issues.

**Sentiment Probability Distribution**

Sentiment Probability Distribution



**Figure 4: Sentiment Probability Distribution**

This figure presents a pie chart showing the sentiment probability distribution of customer reviews. The pie chart segments reviews into three categories: Positive (70.3%), Neutral (22.3%), and Negative (7.4%). The chart visually demonstrates that the majority of reviews are positive, with a smaller proportion of neutral and an even smaller proportion of negative reviews. This indicates a generally favorable customer sentiment toward the product being analyzed.

**Detailed Summary of Sentiment Analysis:**

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Product: 'Bajaj DX 2 L/W Dry Iron' Platform: Amazon Total Reviews Analyzed: 895

**Sentiment Distribution:**

- Positive: 706 reviews (78.88%)
- Neutral: 146 reviews (16.31%)
- Negative: 43 reviews (4.80%)

Overall Sentiment: Positive

Buy Probability: 68.79%

Average Subjectivity: 0.68 (on a scale of 0 to 1)

**Interpretation and Recommendations:**

- **Positive Sentiment:** With the majority of reviews being positive, it indicates that most customers are satisfied with this product. A high buy probability suggests that this product is well-received by its users.
- **Neutral Sentiment:** A significant proportion of neutral reviews may indicate that while the product meets basic expectations, it may not be exceptional. This could be a factor if you are considering purchasing a product with more specific or higher expectations.
- **Negative Sentiment:** The presence of negative reviews should not be ignored. Analyze these reviews to understand common complaints or issues. If the proportion of negative reviews is high, it might be worth reconsidering the purchase or investigating alternatives.
- **Subjectivity:** The subjectivity score indicates how much personal bias or opinion is present in the reviews. A higher score suggests more opinion-based reviews, which could be based on

**Figure 5: Detailed Summary**

These figures describe the sentiment analysis of product reviews and give insights into the likelihood of purchase based on user reviews. There is also an interpretation section that provides recommendations based on the sentiment, like focusing on improving areas where neutral or negative reviews appear.

**V. CONCLUSION**

The Product Sentiment Analysis tool is a powerful application that helps users gain insights into Customer opinions on various e-commerce platforms. By leveraging NLP techniques and providing a user-friendly interface, the tool simplifies the process of sentiment analysis, making it accessible to technical and non-technical users. The subject of sentiment analysis has gained a lot of attention from researchers over the last few decades due to the continuous rise of social media users over the internet. Millions and billions of individuals around the world are using social networking sites like Twitter, Facebook, Instagram etc. for

expressing and sharing their thoughts, beliefs, emotions and opinions about different products, companies and items. As the main focus of this paper is on ABSA, therefore, we reviewed some of the recently published articles related to it. After conducting the review, it is observed that traditionally features were extracted manually from texts for determining their polarity.

## VI. REFERENCES

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