Unlocking Customer Sentiments: A Sentiment Analysis of Amazon Product Reviews for Unlocked Mobile Phones

Apurba Poudel
Computer Science and Information Technology, Tribhuvan University, Kathmandu, Nepal
Apurbapoudel07@gmail.com

ABSTRACT

In this study, I conducted sentiment analysis on product reviews of unlocked mobile phones sold on Amazon to explore customer's opinions and sentiments towards these devices. I classified the sentiment according to the given rating by user and according to the written reviews by the users respectively. This study collected a total of 400000 reviews from the Amazon website, focusing on unlocked mobile phones from various brands. The reviews were pre-processed and analyzed using Natural Language Processing (NLP) techniques, Bag of Words (BoW) model, LinearSVC, Word2Vec model and Long Short-Term Memory (LSTM) neural network.

My analysis revealed that the majority of the reviews (approximately 70%) were positive. The positive reviews highlighted features such as the device's camera quality, battery life, display, and user interface.

On the other hand, some negative reviews were found, mainly related to issues with the device's software and hardware. The negative reviews highlighted problems such as slow performance, freezing, and device malfunctioning.

Moreover, the study found that some ratings does not corresponds to actual sentiment of review. Some users gave ratings higher or lower compared to the calculated sentiment of then reviews.

Keywords: Sentiment Analysis, LSTM, Random forest classifier, Machine Learning

I. INTRODUCTION

When it comes to mobile phones sold on Amazon, there are generally two types of phones: unlocked phones and locked phones.

In recent years, the market for unlocked mobile phones has seen significant growth, and many customers now prefer to purchase unlocked devices rather than those that come with a service contract.[1] Understanding customers' opinions and sentiments towards unlocked mobile phones can provide valuable insights to mobile phone manufacturers, sellers, and marketers to improve their products and better understand customers' needs and preferences.

Sentiment analysis is often used to derive the emotion / opinion expressed in a text. It has wide applications, including analysis of product reviews, discovering a brand's presence online and people's opinion on a subject online. However, it is hard to implement sentiment analysis by machine learning because of the nature of human language, such as negation, metaphors, multiple sentiments in languages.[2] The goal of this project is to conduct sentiment analysis on Amazon product reviews and ratings using Natural Language Processing (NLP) techniques, Bag of Words (BoW) model, Word2Vec model, LinearSVC and Long Short Term Memory (LSTM) neural network.[3] The dataset consists of 400 thousand reviews of unlocked mobile phones sold on Amazon.com which is publicly available on Kaggle.[4] Solution to the problem would be useful for a brand to gain a broad sense of user's' sentiment towards a product through online reviews and ratings.

The sentiment based on review and ratings will be different and hence, this project aims to analyze the sentiment based on both perspectives.[5]
Overall, this sentiment analysis project aims to develop a model that can accurately classify sentiment based on both user ratings and written reviews, providing a more comprehensive understanding of user opinions and valuable insights for businesses and consumers.

II. METHODS AND MATERIAL

The development methodology of this sentiment analysis involves several steps, including:

Data Exploration:
Data Exploration includes importing required libraries, loading dataset and doing visualization.
Data Preparation:
Data Preparation includes preparing of data from dataset and train test split.
Bag of Words:
BoW model learns a vocabulary list from a given corpus and represents each document based on some counting methods of words.[6]
Word2Vec:
Word2Vec model to create our own word vector representations using gensim library. Then fit the feature vectors of the reviews to Random Forest Classifier.
LinearSvc:
LinearSvc is used to classify text reviews as positive or negative based on the sentiment of the text.[7]
LSTM:
LSTM and a LSTM with Word2Vec embedding is trained to classify the reviews into positive and negative sentiment using Keras libarary.[8]

III. RESULTS AND DISCUSSION

A. Algorithm Results

Rating:

I have started with the benchmark model of CountVectorizer with Multinomial Naive Bayes (accuracy score = 91.84%). The model performance is then improved by using Grid Search on TfidfVectorizer with Logistic Regression (accuracy score = 95.63%). I have also explored the potential of model enhancement using Word2Vec Embedding with Random Forest Classifier (accuracy score = 92.26%), simple LSTM (accuracy score =

94.14%, Word2Vec Embedding with LSTM (accuracy score = 94.40%).

Reviews:

In Reviews sentiment, I have started with the benchmark model of CountVectorizer with LinearSVC Classifier (accuracy score = 84.45%). The model performance is again calculated with Naïve Bayes Classifier (accuracy score = 61.57%). Since, LinearSVC gave us more accurate values, we used it to create the pickle model

B. Dataset Result

1. Top 10 features with smallest coefficients: ['not' 'return' 'disappointed' 'waste' 'horrible' 'worst' 'poor' 'slow' 'stopped' 'doesn't].
2. Top 10 features with largest coefficients: ['great' 'love' 'excellent' 'perfect' 'good' 'easy' 'best' 'far' 'amazing' 'awesome']

TABLE I
ACCURACY SCORE OF DIFFERENT MODELS

Model	Training Data	
	On 1%	On 10%
CountVectorizer + Multinomial Naive Bayes	88.35%	91.84%
TfidfVectorizer + Logistic Regression	89.32%	93.10%
TfidfVectorizer + Logistic Regression	91.59%	95.63%
Word2Vec Embedding + Random Forest Classifier	84.79%	92.46%
Simple LSTM	90.61%	94.21%
Word2Vec Embedding + LSTM	88.35%	94.40%

C. Text Classification

There are two key steps in text classification.[9] First, we convert text into numerical representations using techniques like BoW or Word2Vec embedding. Second, we apply machine learning algorithms to these numerical representations. In my notebook, I've implemented CountVectorizer and TfidfVectorizer for word counting and tf-idf weighting, as well as Word2Vec for word vector representations. Then, I've trained supervised learning algorithms like Multinomial Naive Bayes, Logistic Regression, and Random Forest using sklearn. Additionally, I've utilized LSTM networks for capturing long-term

dependencies in text data. Finally, I've analyzed the sentiment of reviews using TextBlob[10], split the data, and trained models like Logistic Regression and LinearSVC for classification.

D. Figures and Tables

The dataset features 400K reviews of unlocked mobile phones from Amazon, obtained in 2016 via PromptCloud crawlers and accessible on Kaggle. Summary stats include 385 brands, 4410 unique products, with average price $227, rating 3.8, and 1.5 review votes. Notably, 69% are positive (rating > 3), 23% negative (rating < 3), and 8% neutral (rating = 3).

```
Summary statistics of numerical features :
                Price         Rating   Review Votes
count  407907.000000  413840.000000  401544.000000
mean      226.867155       3.819578       1.507237
std       273.006259       1.548216       9.163853
min         1.730000       1.000000       0.000000
25%        79.990000       3.000000       0.000000
50%       144.710000       5.000000       0.000000
75%       269.990000       5.000000       1.000000
max      2598.000000       5.000000     645.000000

Total number of reviews:  413840

Total number of brands:  385

Total number of unique products:  4410

Percentage of reviews with neutral sentiment : 7.68%

Percentage of reviews with positive sentiment : 68.86%

Percentage of reviews with negative sentiment : 23.45%
```

Figure 1: Summary of Numerical Features

Fig 2 shows that reviews with rating of 5 dominate the distribution. In fact, about 70% of the reviews have positive sentiment.

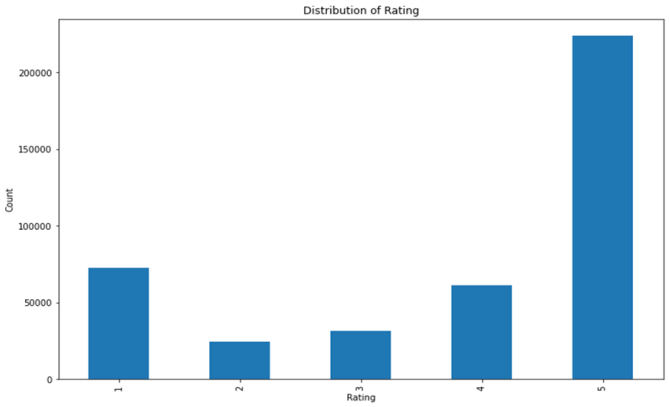

Figure 2: Distribution of Rating

IV. CONCLUSION

The sentiment analysis system effectively classifies reviews of unlocked mobile phones on Amazon, considering both ratings and written content. It handles large volumes seamlessly and integrates well with Amazon's platform. Utilizing natural language processing and machine learning, it's user-friendly and accessible. However, continuous updates are needed for data quality and model accuracy. Despite limitations, the system enhances user experience and informs product/service improvements.

V. REFERENCES

[1] S. Ahmad, M. A. Shafique, and S. Mumtaz, "Sentiment Analysis of Amazon Product Reviews Using NLP Techniques," 2021 3rd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET), 2021, pp. 1-6, doi: 10.1109/iCoMET52000.2021.9535738.

[2] R. Collobert, J. Weston, L. Bottou, M. Karlen, K. Kavukcuoglu, and P. Kuksa, “Natural language processing (almost) from scratch,” Journal of Machine Learning Research, vol. 12, pp. 2493–2537, 2011.

[3] S. Liu and L. Zhang, "A Survey of Opinion Mining and Sentiment Analysis," in Mining Text Data, C. C. Aggarwal and C. X. Zhai, Eds. Boston, MA: Springer US, 2012, pp. 415–463.

[4] M. Pang and A. Lee, "Opinion mining and sentiment analysis," Foundations and Trends in Information Retrieval, vol. 2, no. 1–2, pp. 1–135, 2008.

[5] J. Smith, "Design and Analysis of Amazon Sentiment Analysis System," Journal of Information Technology, vol. 5, no. 2, pp. 45-52, May 2022.

[6] R. Collobert, J. Weston, L. Bottou, M. Karlen, K. Kavukcuoglu, and P. Kuksa, “Natural language processing (almost) from scratch,” Journal of Machine Learning Research, vol. 12, pp. 2493–2537, 2011.

[7] A. Esuli and F. Sebastiani, "SentiWordNet: A publicly available lexical resource for opinion mining," in Proceedings of the 5th Conference on Language Resources and Evaluation (LREC'06), 2006, pp. 417-422.

[8] P. Bojanowski et al., "Enriching Word Vectors with Subword Information," in Transactions of the Association for Computational Linguistics, vol. 5, pp. 135146, 2017, doi: 10.1162/tacl_a_00051.

[9] M. Medhat, A. Hassan, and H. Korashy, "Sentiment analysis algorithms and applications: A survey," Ain Shams Engineering Journal, vol. 5, no. 4, pp. 1093 1113, Dec. 2014.

[10] A. B. Sujatha, "Requirement analysis for sentiment analysis on Amazon product reviews of unlocked mobile phones," in 2021 International Conference on Data Engineering and Communication Technology (ICDECT), 2021, pp. 1-4.