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Research Article

# Classification of Hotel Reviews using Sentiment Analysis

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## Abstract

As technology advances, everyone is communicating their perspectives on numerous sites. Not just online business locales, these days each kind of systematic lodgings, banks, shops, shopping centers are likewise accessible on the web. They're all looking for customer feedback on the internet. Customers express their opinions about the service they receive by writing reviews on the internet. As a result, several hotel reviews are found online. New customers can't make a decision based on the reviews they read because there are so many on the internet. To quickly determine whether the reviews are positive or negative, sentiment analysis is needed. This issue has been resolved by proposing a system that classifies opinions into five different categories using the Support Vector Machine Algorithm. This system also determines the attitude of customers towards aspects like Food, Staff, Room, Ambience, Facilities of a hotel by performing Natural Language Processing (NLP) on the reviews.

**Keywords**—Sentiment Analysis, Support Vector Machine, Natural Language Processing.

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## I. INTRODUCTION

Hotel businesses around the world are gaining knowledge and insight into their services by using appropriate tools to analyze data, such as reviews. With the kind of websites available now, it is easy to gather this data. These reviews generated by the consumer vastly impact the hospitality industry [1]. Individuals tend to read reviews from former clients before deciding whether or not to use a product or service. This is due to people's proclivity for basing their decisions on the actions of others. The Sentiment analysis of words feature of the Natural Language Processing makes it possible to analyze all the reviews and to classify them [2].

Customers in the hospitality industry often share their experiences through feedback and reviews on hotel services. Customers are encouraged to offer similar recommendations on a shared forum as social media evolves. Customer input is important in order to strengthen the services delivered in the future. The information in the reviews contains a lot more information that can help hotels enhance their results. It sets aside a long effort to peruse the entirety of the reviews. The sentiment is the primary point in this industry as the majority of the people who stay are from other places and they would like to be comfortable [3]. Thus, using advanced information tools and analytics techniques, the aggregation and classification of reviews may be achieved using social media analytics. As a consequence, the data a part of the methodology and method of social media analytics comprised of Data Analytics, Text Mining, and Sentiment analysis.

In the hospitality industry, social media analytics can have a major influence. However, the study focuses on sentiment analysis on reviews present on goibibo.com website. This study utilized Machine Learning Algorithm such as Support Vector Machine (SVM) based on Natural Language Processing (NLP). Not only SVM, but we can also use Neural Networks [4] and Naive Bayes [5].

Customer feedback can be analyzed using aspect-based sentiment analysis, which associates particular emotions with various aspects of a product or service. Till now the aspect-based analysis focused on product reviews from e-commerce websites [6] and tweets from Twitter [7]. The proposed model performs aspect-based sentimental analysis on hotel reviews.

The use of aspects provides a bird’s eye view of the quality of the hotel and its services based on the primary aspects such as room, food, staff, facilities, and ambience. It is

generally done by using topic modeling by Latent Dirichlet Allocation [8]. The proposed model uses NLP based technique called parts of speech tagging for extracting an aspect and the sentiment of the aspect.

The main objective of this paper is to extract reviews on hotels from the web using web scraping, to classify the reviews into five different categories using sentiment analysis, to determine the attitude of customers towards certain aspects like Food, Staff, Room, Facilities, Ambience of a hotel and finally to visualize the results to the customer in terms of the Bar plot which is very helpful to customers instead of reading all the reviews and remembering them.

The latter sections of the paper are ordered as follows: Literature survey has shown in section 2.The elaborate explanation of the proposed work has shown in section 3. The results of the proposed work are shown in section 4. The conclusion of the proposed work is shown through section 5.

## II. LITERATURE SURVEY

Shanshan Yi, et. al [9] proposed a framework that uses sentiment analysis on consumer experiences posted through social media channels to suggest a shop that offers the best items. HRS (Hybrid R System) was used to extract five basic features from customer data in this article. For classification, the proposed method employs a multiclass support vector machine (MSVM). This method does not meet the needs of collecting consumer interest in various goods through multiple geographic locations. The model fails to account for external variables that could have an effect on the conversations that take place on Twitter.

Ghorbani, et. al [10] proposed a system where Deep learning algorithms with word embedding are used in Sentiment Analysis (SA) and Opinion Mining (OM). This model extracted the characteristics using a CNN layer, which was then sent to a bidirectional LSTM layer to learn long-term dependence. To boost sentiment analysis performance, this model has chosen the CNN algorithm and the LSTM. The main aim is to establish a suitable solution for evaluating emotions and categorizing them into positive and negative categories. For carrying out sentiment analysis this model employed deep learning algorithms like LSTM and CNN. To acquire vector representations for terms, this model utilized the GloVe word embedding layer, pre-prepared word vectors, and an unsupervised learning algorithm.

Ali Shariq, et. al [11] proposed a model which portrays how various societies reacted and responded to a particular crisis in society, as well as the political will to resolve the problem.

Joy, surprise, sadness, fear, rage, and disgust are the only emotions studied in this review. This model, which is divided into two phases, uses natural language processing (NLP) and deep learning methods. The sentiment polarity classifier is the first step, which categorizes tweets as positive or negative. The first phase performance is then fed into an emotion classifier, which attempts to assign a tweet to one of two positive emotion classes (joy and surprise) or one of two negative emotion classes (fear and anger) (sad, disgust, fear, anger). To detect emotion, deep learning models are used.

Trivanna Widiyaningtyas, et. al [12] proposed a system where a Supervised Machine Learning Algorithm is employed. This model used Trip Advisor Dataset and performed Tokenization using the n-gram method. This model used the Naive Bayes method for classification. This system will create a word for each feedback that depicts the state of mind of the feedback as positive or negative. This system preferred unigram token to bigram and trigram based on the precision obtained.

Li Yang, et. al [13] proposed a model for evaluating the sentiment tendency of consumer evaluations that will help companies on online shopping platforms enhance service quality and customer loyalty by providing a guide for other customers. The proposed model is a sentiment analysis model focused on the advantages of sentiment lexicon, word vectors, CNN, GRU, and the attention system, and it is tested on a book review dataset from a real e-commerce book website. To begin, the sentiment lexicon is applied to the reviews to improve the sentiment features. In the proposed work they have employed CNN and GRU networks to draw the most important sentimental and qualitative aspects of the feedback, which are then weighed using an attention mechanism. Finally, the model eventually classified the weighted sentiment features.

Muhammad Afzaal, et. al [14] proposed a system that provides a mechanism for aspect-based sentiment classification that will effectively and efficiently classify and categorize the aspects. This system is introduced as a mobile application that assists prospective visitors in finding the best hotel or restaurant in the region and its efficiency has been tested with excellent results using real-world datasets. In this model a tree-based aspects extraction strategy is employed that removes both unequivocal and verifiable viewpoints from vacationer assessments. This model extracts common nouns and noun phrases from reviews text then uses WordNet to group related nouns.

TABLE I. SUMMARY OF RELATED WORKS

| **Study** | **Method** | **Algorithm** | **Feature** | **Outcome** |
|---|---|---|---|---|
| Tyagi Priyanka [17] | Supervised method | K-Nearest Neighbour | 3-point scale classification, Tokenization | The proposed system gives an accuracy of 80% (approx) |
| Sayyed Johar, et.al [18] | Supervised method | Naive Bayes, SVM | Bag of words, TF-IDF | The model classifies entire dataset into positive and negative comments. |
| A.R.S. Silva et. al [19] | Supervised method | SVM, Latent Dirichlet allocation | Tokenization,Topic Modelling, Ontology incorporation | The study analyzes the reviews, identify domain and category of each review. |
| Brian Keith Norambuena, et. al [20] | Supervised method, Unsupervised method, Hybrid Approach | SVM, NB Scoring algorithm, HS-SVM | POS Features, dictionaries | The model obtained improvement by combining the Scoring algorithm and the SVM |
| Proposed System | Supervised method | SVM, NLP | POS Tagging, 5-point scale review classification, Aspect's opinion score computation | The model takes less training and prediction time. The model |

| | | | | |
|---|---|---|---|---|
| | | | | identify aspect in each review and provide it's corresponding opinion score. |

Kudakwashe Zvarevashe, et. al [15] proposed a framework that provides a method for Aspect-based sentiment classification that will effectively and efficiently classify and categorize aspects. In this model reviews are obtained using a crawler and APIs from popular social media platforms for data collection. They used the Intuition model and a sentiment polarity-based model in this paper. The Intuition model will simplify the implementation of a classification algorithm for data training and testing. The next step is to choose an acceptable classification algorithm, and the final step is to train and test the algorithm on the dataset, as well as to record the results.

Diana Gavilana, et. al [16] proposed a framework that investigations the effect of good versus terrible appraisals in the main phase of the decision-making cycle when booking lodging. This framework will test the cooperation between ratings given to a commodity or service and the number of verbal reviews it has gotten while controlling subject defenselessness to relational impact. They have proposed an intervention impact of trust in the connection between the rating and the inn thought. The fundamental objective of this model was to also assess the effect of online assessments and the quantity of inputs on the point of individuals to join a particular offer in their idea set while they are searching for information during the primary phase of the decision making step.

## III. PROPOSED SYSTEM

In the proposed system, Text mining and Sentiment analysis techniques are used. To build the proposed system Python is used to perform sentiment analysis because it does great work and provides precise and clear visual representations in the form of graphs and plots.

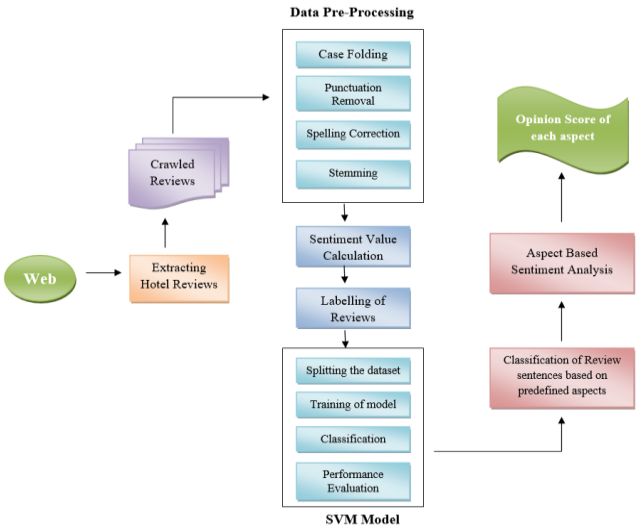


Fig. 1.Proposed System

The proposed model shown in Fig 1 consists of the following steps:

*A.* Data Collection

Data is collected from an online website called "Goibibo.com". Using Beautiful soup, package reviews of a particular hotel are extracted. The extracted reviews and names of customers are made as columns and the dataset is constructed using Pandas Package.

*B.* Data Pre-processing

Before providing the data to the model for classification, it needs to be in the right format. Data pre-processing is performed to get cleaner data, which makes it easier to process the data further to get useful information. The steps required to pre-process the data are shown in Fig. 2.

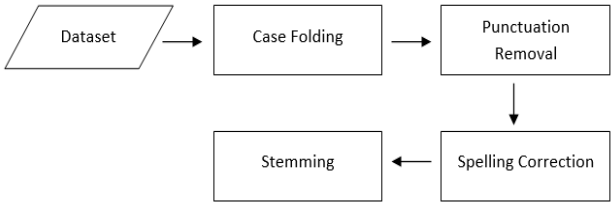


Fig. 2. Data Pre-processing Steps

*1.* Case Folding

The process of converting all uppercase letters into lowercase letters is called Case Folding. In this step, every letter in the sentence will be converted into a lowercase letter.

*2.* Punctuation Removal

Special characters like @, #, *, $ are replaced with whitespace, and unnecessary

punctuation marks are removed.

*3.* Spelling Correction

Spelling mistakes in reviews are corrected by using a package called TextBlob.

*4.* Stemming

The method of reducing a word to its word stem, which attaches to suffixes and prefixes is called Stemming. The output we will get after Stemming is called 'lemma'. After Stemming, we will be getting a valid word that means the same thing.

*C.* Sentiment Value Calculation

In this step, the reviews and opinions are further analyzed to calculate the sentiment polarity and subjectivity. TextBlob, a Python built-in library, is used in the proposed system.

*D.* Labelling Of Reviews

In this phase, each review is assigned with a label like 'Very Good', 'Good', 'Average', 'Bad', 'Very Bad' based on the sentiment value calculated in the above step.

1) If the sentiment value is in the range of (-1,-0.5) then the 'Very Bad' label is assigned for that review.
2) If the sentiment value is in the range of (-0.5,0) then the 'Bad' label is assigned for that review.
3) If the sentiment value is in the range of (0,0.35) then the 'Average' label is assigned for that review.
4) If the sentiment value is in the range of (0.35,0.7) then the 'Good' label is assigned for that review.
5) If the sentiment value is in the range of (0.7,1) then the 'Very Good' label is assigned for that review.

*E.* Creation of Linear SVM Model

Once labeling is done, the reviews dataset has to be split into training and test sets in the ratio of 80:20. The train test split method can be used to accomplish this. The training data is now used to train the SVM. Since the grouping task is played out, the Support Vector Classifier class is utilized. The kernel form is the only parameter for this class. Since simple SVMs can only classify linearly separable data, this parameter is simply set to "linear" in the case of a simple SVM. To make predictions, the prediction method of the SVC class is used.

When using different types of classifiers, an assessment should be performed to analyse the performance of classifiers when it is predicting the class labels. To analyse the performance of the classifiers, three measurements were used which are known as F1-score, precision, and recall value. Their equations are as follows:

F1-score = (2*Precision*Recall) / (Precision+Recall)

Precision = TP / (TP + FP)

Recall = TP / (TP + FN)

Where TP is denoted as True Positive value, TN is the True Negative value, FP is the False Positive value and FN is the False Negative value.

### *F.* Aspect Based Sentiment Analysis

In this step, most commonly known aspects like Food, Ambience, Staff, Facilities, Room are defined. Initially, two variables named positive_score and negative_score are taken for each pre-defined aspect and are assigned to zero. After that, the reviews pertaining to each aspect are picked up from the review set. The pre-defined aspect of each review and its corresponding words with adjective or adverb tags has to be identified. The sentiment value for each corresponding word of aspect is calculated. Now, for each positive sentiment value the positive_score variable is incremented, and for each negative sentiment value the negative_score variable is incremented. Finally, the positive percentage (positive opinion score) and negative percentage (negative opinion score) of reviews for each aspect is calculated.

## IV. RESULT AND ANALYSIS

The proposed Classification model takes hotel reviews as input from goibibo.com website. The model has taken Fortune Hotel, Mumbai from the goibibo.com site as input for extracting that hotel's reviews. The model is classifying each review into one of the categories (Very good, Good, Average, Bad, Very Bad) based on the sentiment value. The model has trained using 80% of the data and the remaining 20% as test data. Fig 3 shows the visualization of sentiment analysis for reviews of Fortune Hotel.

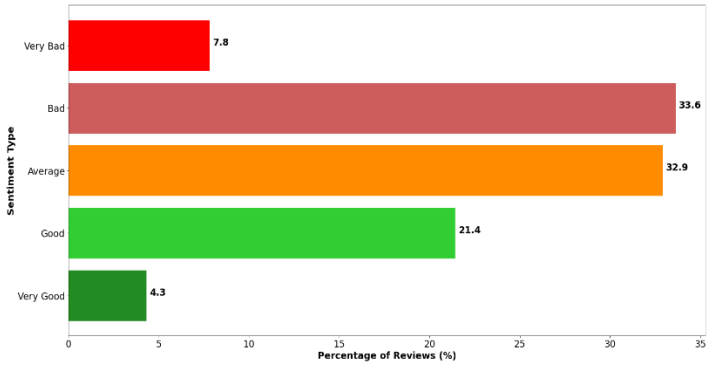


Fig. 3. Hotel Sentiment Analysis

The bar plot shown in the above Figure can be analyzed as follows.

- The percentage of customers who rated the hotel as ‘Very Good’ is 7.8%
- The percentage of customers who rated the hotel as ‘Good’ is 33.6%
- The percentage of customers who rated the hotel as ‘Average’ is 32.9%
- The percentage of customers who rated the hotel as ‘Bad’ is 21.4%
- The percentage of customers who rated the hotel as ‘Very Bad’ is 4.3%

The result shown in the below figure is the classification report of reviews using the Support Vector Machine model.

```
Training time: 0.051902s; Prediction time: 0.008935s
Very Good:  {'precision': 0.0, 'recall': 0.0, 'f1-score': 0.0, 'support': 6}
Good:  {'precision': 0.7727272727272727, 'recall': 0.7906976744186046, 'f1-score': 0.7816091954022988, 'support': 43}
Average {'precision': 0.6818181818181818, 'recall': 0.7317073170731707, 'f1-score': 0.7058823529411764, 'support': 41}
Bad {'precision': 0.5384615384615384, 'recall': 0.6666666666666666, 'f1-score': 0.5957446808510638, 'support': 21}
Very Bad {'precision': 1.0, 'recall': 0.2, 'f1-score': 0.33333333333333337, 'support': 5}
```

Fig. 4. Results of SVM

Fig 4 shows the results of SVM for test dataset. From the above Figure, it can be observed that training time and prediction time are small. F1-score is used to measure the accuracy. F-Measure gives a solitary score that adjusts both the concerns of precision and recall in one number. It is observed that categories “Good” and “Average” have high F1-score because more number of reviews are likely to fall under those categories. It is also observed that categories like “Very good” and “Very bad” are having low F1-score as these categories are having less number of reviews. It is noticed that if a category has zero precision and zero recall then its F1-score will also be zero because F1-score is calculated based on the values of Precision and recall.

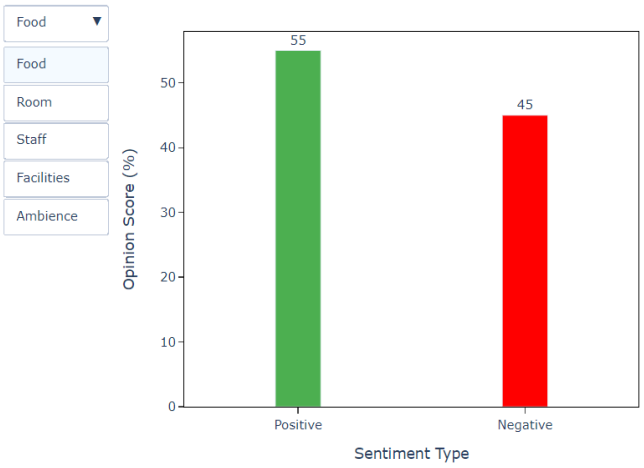


Fig. 5. Food Aspect

Fig 5 shows the bar plot of the Opinion score of aspect Food. It clearly states that positive and negative scores of aspect Food are 55 and 45 respectively.

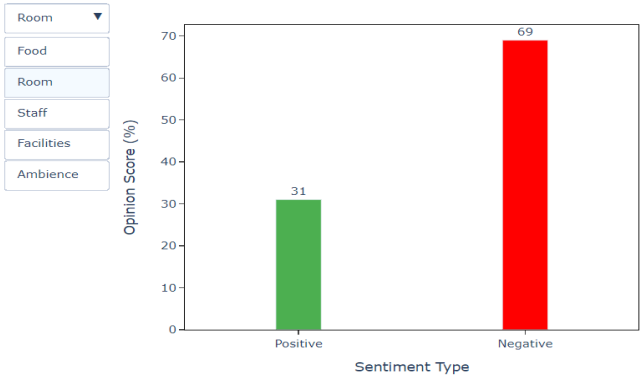


Fig. 6. Room Aspect

Fig 6 shows the bar plot of the Opinion score of the Room aspect. This aspect has a positive score and a negative score of 31 and 69 respectively.

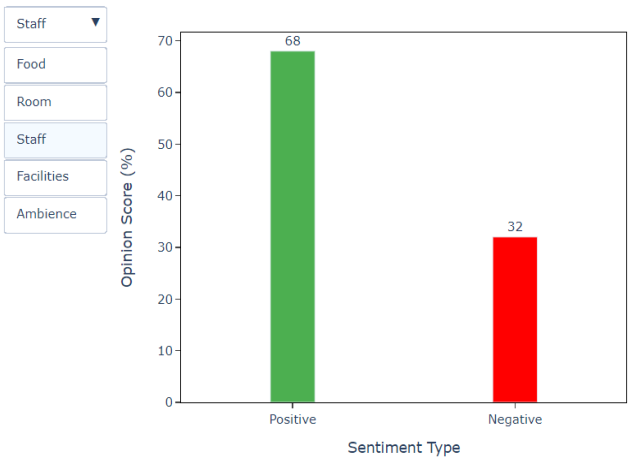


Fig. 7. Staff Aspect

Fig 7 depicts the bar plot of Staff Aspect's Opinion Score. This aspect has positive and negative scores of 68 and 32 respectively.

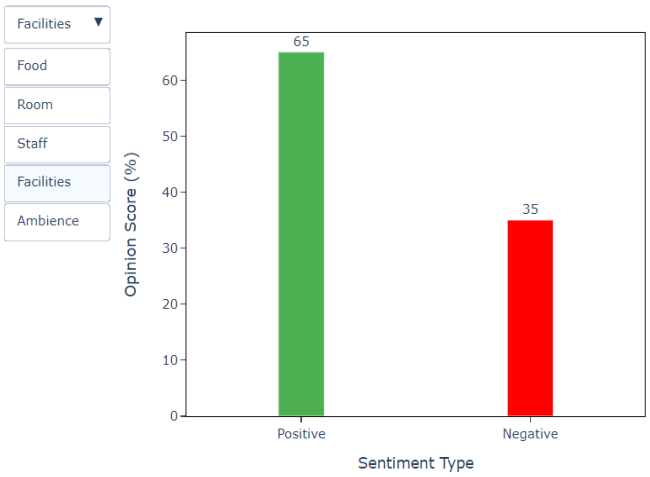


Fig. 8. Facilities Aspect

Fig 8 illustrates the positive and negative score of Facilities aspect as 65 and 35 respectively in terms of a bar plot.

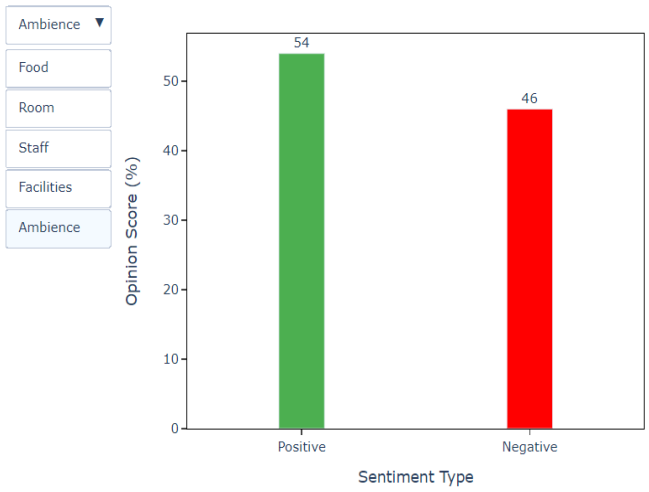


Fig. 9. Ambience Aspect

Fig 9 depicts the bar plot of the Opinion score of Ambience aspect. It describes the distribution of positive and negative scores as 54 and 46 respectively.

## V. CONCLUSION

The model classifies the reviews into five different categories like very good, good, average, bad, very bad, and shows the percentage of reviews that come under each category in terms of the bar plot. The model works well even if large data is retrieved from web pages. More data will be used to train the model in the presence of large data, which will increase

the model's accuracy. On a whole, the model interprets the reviews given by the customers and classifies them. The model finds the predefined aspects of the reviews set and determines the attitude of customers towards certain aspects like food, staff, room, facilities, and ambience through online feedback given by them for a hotel. Also, the model visualizes every aspect's opinion score in terms of the bar plot by clicking the particular aspect.

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