

Machine Learning based Airlines Tweets Sentiment Classification

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ABSTRACT

Sentiment Analysis is one of the key research areas under the machine learning. In this research, the sentiment analysis is applied on the tweets which are based on airlines services. Sentiment analysis is done to classify the sentiments into either positive or negative. Various supervised and unsupervised machine learning algorithms are applied and their accuracy scores are estimated. Based on the accuracy score estimation the best machine learning algorithm for sentiment analysis is identified. The Experiment is carried out with the help of 14640 Airlines related tweets. Support Vector Machine algorithm shows the highest performance accuracy results of 90% and the lowest accuracy result of 79% is given by Decision tree machine learning algorithm. The result shows Support Vector machine algorithm performs better for the sentiment analysis of airlines tweets.

Keywords

Sentiments, Tweets, Machine Learning, Accuracy score, Classification.

1. INTRODUCTION

Airlines is one of the best fastest modes of transportation. There are thousands of airlines service providers across the world. Every second thousand of people across the world book their flights from source to destination. Some airlines services provide good facility and gain customer satisfaction while some airlines service failed to gain customer satisfaction. Customer Satisfaction is very important aspect to make growth in business. but the question is how to gain customer satisfaction? How businesses came to know where the services are not good? Where and how to improve the service? So, the answers for this question is customer reviews. Reviews are nothing but the feedback provided by the user after using business service. For all the services in a world, reviews or opinions or feedback plays a significant role in the growth of the business[1]. so, the researchers find one way to analyze people sentiments in the form of reviews or opinions or feedback. Twitter is one of platforms where one can find people thoughts. People express their emotions, likes, compliments, feedback etc. in the form of tweets. Tweets are the thoughts or opinion or reviews given by the people. If the tweets contain positive feedback for the service offered that means the customer is satisfied and contains positive sentiments. Similarly, if the tweets contain negative feedback that means the customer is not at all satisfied with the service offered and contains negative sentiments. If the sentiment is neither negative nor positive then it is considered as neutral. In this way with the help of tweets one can easily identify the sentiments. one of the ways to study user tendency is by using user's opinions through tweets.

Sentiment Analysis is the study of sentiments present under the reviews or tweets. Sentiment analysis can be done with the help of machine learning algorithms. There are various types of machine algorithms therefore various algorithms are applied to perform sentiment analysis. Sentiment analysis can be performed using three methods i.e., lexicon based, machine learning based and hybrid [2]. TFIDF i.e., term frequency and word embedding are also applied to the datasets [3]. Based on the applied algorithm different accuracy scores is achieved. Based on the experiment support vector machine is the best machine learning algorithm and its shown highest accuracy score of 90%. Sentiment analysis is mainly carried to classify the sentiments into one or more categories like positive, negative and neutral. Various python libraries are used for the sentiment classification and accuracy score analysis like numpy, pandas, matplotlib, seaborn, plotly, nltk (natural language processing), wordcloud, sklearn, imblearn, xgboost etc. Sentiment analysis can be done with help of variety of machine learning techniques [4][5] as well as various feature selection techniques like mutual information [6] and many other. some researchers perform sentiment analysis on the collected tweets from twitter and classified it into positive, negative and neutral using the technique called valence aware dictionary and sentiment reasoner, the statistical significance among the groups is also shown [7]. Sentiment analysis is also performed using the polarity the sentiment-based polarity model and hybrid cuckoo search is defined and based on these results are determined [8][9]. The polarity is nothing but a sentiment score between 0 to 1[10]. Sentiment analysis is also applied in E commerce sector using naïve bayes and support vector machine learning algorithm [11]. The fake online reviews as well as tourism reviews can be detected and classified using machine learning sentiment analysis [12][13]. Sentiment analysis using Word2Vec CNN BiLSTM estimated the accuracy score of 91.48%[14][15].sentiment analysis is applied to opinion mining using self-reported attitude scores[16]. Classifier Ensemble approach is used to perform sentiment analysis on election results [17]. Online social media, microblog short messages [18] and social network [19]reviews sentiment analysis is performed on US Airlines tweets using various machine learning algorithms like adaboost, decision tree, knn, linear svm etc[20][21]. Deep learning models are used to detect airlines service quality [22][23][24]. Genetic algorithm [11], latent Dirichlet allocation [25], latent Dirichlet allocation [26] lexicon based algorithm [27], RNTN, FRN, Unsupervised Fuzzy Clustering Method [28] algorithm are the prominently used algorithms to carry out sentiment analysis in various domain. Sentiment analysis is also applied on a imdb dataset to predict sentiments based on the movie reviews, the aspect based sentiment analysis[29] is done to perform sentiment classification[30][31]. Logistic Regression, BERT and VADER are applied to perform sentiment analysis of covid19 tweets based on the experiment BERT shown highest

accuracy results as compare to VADER and logistic regression [32]. SD-Naïve bayes, N gram Naïve Bayes, N gram support vector machine and text CNN sentiment classification algorithm is applied to danmaku videos dataset [33]. After analyzing results they SMOTE process are also used to determine more accuracy [20]

2. LITERATURE SURVEY

WajdiAljedaani, Furqan Rustam [34], Performed sentiment analysis based on the Six USA Airlines dataset. The architecture of the proposed research consists of data collection of 14640 tweets, data preprocessing, feature engineering, splitting of the data, lexicon-based sentiment analysis, applying deep learning [35] as well as machine learning algorithms, data prediction and based on the data prediction the trained model evaluation is carried out. The dataset consists of 3 types sentiments i.e., positive, negative, neutral. With the help of textblob model accuracy is improved to perform classification. Results of research shows that using TF IDF & LSTM 92 % & 97% of accuracy is achieved.

E Prabhakar, M Santhosh, Hari Krishnan, T kumar, R Sudhakar [36], They Proposed a sentiment analysis of top 10 airlines services reviews in US using one of the popular machine learning techniques Adaboost. Tweets or reviews present in English language are considered. To check the accuracy and analysis of performance recall, precision, F score is calculated using various machine learning algorithms. They started with data collection from top 10 airlines service reviews or tweets, preprocessing of the collected data is carried out to remove unwanted data. For the main analysis purpose, the 75 % of the data is taken for the training and remaining data is used for the testing. Bagging and boosting ensemble [37] techniques are applied to train the model. The New approach called as Adaboost results with the higher accuracy. The second highest accuracy score is given by the random forest algorithm. The New Approach Ada boost gives the precision of 78%, recall of 65%, and the F score of 68%. And the random forest algorithm gives the precision of 71%, recall of 66%, F score of 60%. Therefore, one can easily decide to choose best model based on the accuracy results.

Ankita Rane, Dr. Anand Kumar [38], Sentiment analysis of US Airlines tweets are carried out using multi class classification. The dataset is taken from Kaggle released dataset by CrowdFlower which comprises of 6 major US Airlines Services and total 14640 tweets. Doc2Vec and word embedding techniques is used on preprocessed tweets to perform analysis at phrase level. this analysis is done using 7 different machine learning classification algorithms. The dataset is separated into 2 parts, 80% of the data is used to train the model and 20% of the data is used for testing. The results are either positive or negative or neutral. Spyder tool is used to do entire experiment. The data visualization is done for solving business problems such finding the root cause of negative reviews as well as finding the total sentiments counts. As compare to all other machine learning algorithm applied accuracies, Ada Boost Algorithm shows the highest accuracy of 84.5%.

Ankit, NabizathSaleena [39], Discussed the sentiment analysis of the tweets or review using Ensemble Classification and using base classifiers. The sentiment classification is classified into 2 categories i.e., positive and negative. Neutral sentiment is not taken into consideration. The research process consists of 4 main steps, initially the data preprocessing is carried to cleaning the data, then the feature extraction is carried out to extract only essential features from the data. For the feature

extraction one of the popular feature extraction techniques called Bag of Words is applied. the sentiment classification is done using various base classifiers and the ensemble classifier. The applied base classifiers techniques include naïve bayes, random forest, support vector machine (SVM) & logistic regression. In ensemble classifier model, the inputs are test tweets and the output is its sentiment score. Sentiment score is calculated based on the probability. If the input test tweet has more positive score, then negative then it is considered as given test tweet is of positive sentiment. Similarly, if the test tweet has more negative score than the positive score it is considered as the given test tweet is of negative sentiment. Results are calculated and data visualization is shown using graphs. The ensemble classifier shows better results as compared to others.

3. SYSTEM ARCHITECTURE

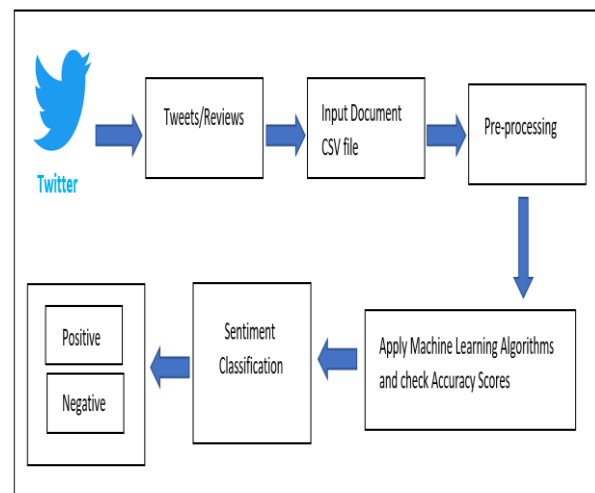


Figure 1 System Architecture of Sentiment Classification

Figure 1 shows the architecture of the Sentiment Classification System. The data of tweets is collected from twitter and it's loaded in CSV (comma separated values) file. The CSV file is used as an input to the system. Pre processing is carried out on an input data which includes removing hashtags, removing stop words etc. The machine algorithms like SVM (Support vector machine), Logistic Regression, Decision tree and boosting are applied. Based on the Accuracy scores and confusion matrix of each applied algorithm SVM shown better performance with the accuracy score of 90.7 %. The sentiment classification shows the results in the form of either positive or negative.

Dataset Details

The dataset consists of tweetid, airline sentiment, airline_sentiment_confidence, negativereason, name of airline service, son who has tweet, retweet count, tweet text, tweet_coord, tweet_created, tweet_location, user_timezone. All the real time tweets from various airlines services like air india, indigo, Vistara, virgin America, united, delta etc are collected for effective sentiment analysis. There are around total 14640 tweets. Float, Object and integer are the accepted datatypes in the dataset. 75% of the data is used for training and 25% of data is used for testing.

Data Preprocessing

Before sending data to the machine learning model the data preprocessing is carried out to make sure data must be in a proper structured format. As the dataset contains unwanted data which affects the machine learning model to give better accuracy results. The unwanted columns from the dataset like

name of person who tweet, retweet count etc. are dropped. All the duplicates are values also removed. The punctuation marks, URL, hashtags, stopwords, HTML Tags, mentions, emojis are also removed. The TF-IDF technique is done to calculate term frequency and inverse term frequency. The SMOTE process is applied to balance the data.

Models Used

The machine learning models used for sentiment analysis are

1. Boosting

Boosting is one of the ensemble techniques mainly used to build the classifier.

2. Support Vector machine

Support vector machine is a supervised machine learning technique primarily used for to solve classification related problems. Based on the vector line the data points are classified into the categories.

3. Decision Tree

The Decision tree is a supervised machine learning algorithm creates a tree structure classifier which contains nodes and branches. Based on the nodes and branches condition the decision can be made.

4. Logistics Regression

Logistic regression is a supervised machine learning technique used to solve classification problems it is used to classify the given datapoints and can easily predict the classification category.

4. EXPERIMENT RESULTS

Various Machine learning algorithms are applied to check and identify best algorithm with the higher accuracy. Based on the Machine Learning Algorithms accuracies the boosting algorithm shown the accuracy score of 85.7%. The support Vector Machine algorithm came up with the accuracy score of 90%. The Decision tree machine learning algorithm shown the accuracy of 79%. The Logistic Regression machine learning algorithm shown the accuracy score of 85.9%. Therefore, based on the experiment it proved that the support vector machine is the best algorithm for airlines tweets sentiments classification.

Table.1 Accuracy Results

Algorithm	Accuracy score
Boosting	85.7%
Support Vector Machine	90.7%
Decision Tree	79.9%
Logistic Regression	85.9%

5. CONCLUSION

The main aim to carry out this experiment is to analyze the sentiments behind tweets related to airlines and identify which machine learning algorithm gives best accuracy results. Based on the algorithms applied – algorithm shown the best results with the higher accuracy score as compare to others.concluding that support vector machine is the well suited algorithm for sentiment analysis of airlines tweets. This model not only helps customers to choose best airline service but also to service providers to improve their own services. Once the airline services identify their areas to improve, they will start working on how to improve, it helps people to enjoy their tours using

airlines services and it will also help to boost global economy. In futuresome more machine learning algorithms can be applied so that the accuracy scores can be analyzed more precisely.

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