Image Sentiment Analysis

Amit Misra

(Department of Information Technology,KIET College, Ghaziabad, India)

Abstract

The paper presents an approach to perform the sentiment analysis of the text-based images. Recently, a rapid growth in the use of images to express emotions has been observed in the social media. This paper presents the sentiment analysis or opinion mining of the text-based images which are frequently occurring in the social media such as Twitter, Facebook, Instagram, Flicker. The paper uses the collaborative approach of text extraction from the image and followed by sentiment analysis of the extracted text using the multinomial Naïve Bayes.

Keywords: *Naïve Bayes, Opinion Mining, Sentiment analysis, Text Extraction.*

1. Introduction

Sentiment analysis or opinion mining are fields ofstudy that analyze people's opinions and emotions.Sentiment analysis [1] is the process of analyzing individual's perspective towards a certain person, brand or thing. It includes retrieval of information from the text in order to understand that whether the text has positive or negative sentiment. It has a wide scope in all major domains such as brand analysis, predicting political elections, health care.

In current scenario, the social media has become the major part of our lives and the great source of information. According to statistics provided by Staticia [2], daily time spent on social networking by internet users worldwide increased from 90 minutes in 2012 to 135 minutes in 2017. Rapid growth has been observed in social media for using text-based images to express their opinions. The tweets with images are given more priority thantext-only tweets. It is also mentioned by Sproutsocial [3]that tweets with images are 150% more likely to get retweets than text-only tweets. Social media images from Flicker, Instagram, Facebook provide a potential source for understanding public sentiments.

This paper presents the sentiment analysis of text-based images which includes the collaborative approach of extraction of text from images and sentiment analysis of the text. The paper follows the supervised learning [4] approach for sentiment analysis. Supervised learning is applied when data used to train the algorithm is already labeled with correct answers. Sentiment Analysis is amongst the popular research area and ample of the work has already being done on both text and image sentiment analysis. This paper deals only the images with text so that sentiment analysis of text-based images can be performed.

Fig. 1 shows the text-based images which are used for sentiment analysis. The process includes retrieving the text from the similar kind of images and then performing the sentiment analysis of the extracted text which further predict that image has positive or negative sentiment.

Fig. 1 Images with the text.

2. Related Work

In recent past, sentiment analysis has become a great attraction for researchers since much of the work has already been performed on text-based sentiment analysis. The shift has been witnessed in the sentiment analysis of the visual content also. In this section, the literature closely related to our study emphasizing on sentiment analysis of text-based images has been reviewed.

Caiand Xia [5] have proposed a method which uses the combination of text and images rather than dealing with each separately. It uses the Convolutional Neural Network (CNN) approach for textual features and visual features. Quanzeng and Jianchao [6] have proposed a design based on CNN architecture for image sentiment analysis. They have obtained half a million training samples by using a baseline sentiment algorithm to label Flickr images. Gajarla and Gupta [7] have tried to predict the overall emotion of the image and further divide every image into different categories like- Love, Happiness, Violence, Fear, and Sadness. This has been performed by fine tuning of three different CNN for the tasks of emotion, prediction, and sentiment analysis.Wang et. al. [8] have used the unsupervised sentiment analysis approach to bridge the gap between contextual information and visual content to predict the image sentiment.Text extraction overview is provided in the R.Smith work [9]. It has been performed by using the Tesseract optical character recognition engine. It has involved the identifying characters present on the images and extracting them. Troussas et. al [10] have provided the classification approach using Naïve Bayes classifier to perform the sentiment analysis of facebook statuses. Parveen and Pandey [11] have also given an approach for the text-based sentiment analysis. They have used the Naïve Bayes classifier and Hadoop framework for processing data on twitter dataset and finally predicting the sentiment.

3. Proposed Work

In this work, an approach has been proposed to perform the sentiment analysis of text-based images. In this approach, the first step includes the extraction of the text from the text-based images. It is achieved by using the Tesseract-OCR module [9] provided by Google. The preprocessing of the extracted text is performed by count vectorization method of Scikit learn library. This method is used for the tokenization of the text while the other half includes the training the model using 37813 tweets dataset which tells the sentiment of the image i.e. positive or negative. The multinomial Naïve Bayes [12] model is used for training which is suitable for classification with discrete features. Finally, the sentiment analysis of the image is performed which tells about the positive or negative sentiment of the image.

3.1 Data Collection and Cleaning

This subsection deals with data acquisition. Data is taken from https://data.world/crowdflower/sentiment-analysis-in-text which consists of 40000 tweets which are divided into multiple categories such as hate, anger, happiness, love, neutral etc.

The above mentioned categories of data are further reduced into two broad categories namely positive and negative tweets. This reduces the dataset to 20716 tweets. Further, 1 and 0 values are assigned to positive and negative tweets respectively. This process of data cleaning also includes [13] converting tweets to lowercase, removal of hashtags and various punctuations.

3.2 Development of a Dataset

Table1: Dataset Statistics

Dataset	**Positive**	**Negative**	**Total**
Training	11138	6470	17608
Testing	1974	1134	3108

The dataset is the combination of positive and negative tweets. Further, the dataset is divided into the 85% training data and 15% testing data. Table 1.0 shows the division of data into the training and testing. The division of data is necessary to calculate the training accuracy of the model i.e. how well the model will behave to the unseen data. In this paper, the accuracy of 77.6% is achieved.

3.3. Sentiment Classification

The Support Vector Machine (SVM) [14] and Naïve Bayes have proven great for the sentiment classification. The paper uses Naïve Bayes [15], the popular supervised classifier in order to classify whether the sentence has positive or negative sentiment. Naïve Bayes is based on Bayes Probability theorem. It is simple and efficient text classifier hence used in multiple domains such as spam filtering in e-mails, topic classification, and sentiment analysis. Bayes theorem forms the core part of the Bayes classifier which is stated as:

$$\textbf{Posterior probability} = \frac{\textbf{Likelihood} \times \textbf{Prior probability}}{\textbf{Evidence}}$$

The general form of posterior probability can be written as:

$$P(w_j|x_i) = \frac{P(x_i|w_j) \times P(w_j)}{P(x_i)}$$

where x_i denotes the feature vector $i \in \{1,2,..,n\}$, w_j denotes the class $j, j \in \{1,2,..,m\}$ and $P(x_i|w_j)$ denotes the probability of the feature x_i when class is w_j given. In our work w_j represents the labels as positive and negative sentiments.

Conditional Probability

Naïve Bayes classifier refers to the conditional independence of each feature i.e. it treats each feature independently. The likelihood or conditional probability can be calculated as:

$$P(x|w_j) = \prod_{k=1}^{d} P(x_k|w_j)$$

$P(x|w_j)$ Refers to the conditional probability for the feature x when the classlabel is given where d represents the dimension of the feature vector$x$. Maximum likelihood estimation is used to calculate the conditional probability for each feature $x$which is given as:

$$\hat{P}(x_i|w_j) = \frac{C_{x_i,w_j}}{C_{w_j}}$$

where,C_{x_i,w_j} refers to the count of feature $x_i$for the given class $w_j$whileC_{w_j}refers to the total count of the particular class.

3.4. Text Extraction

In order to determine the sentiment of text-based images, the extraction of text [16] from the images plays the vital role. In this paper, the Tesseract OCR module has been used in our python script for extraction of text.

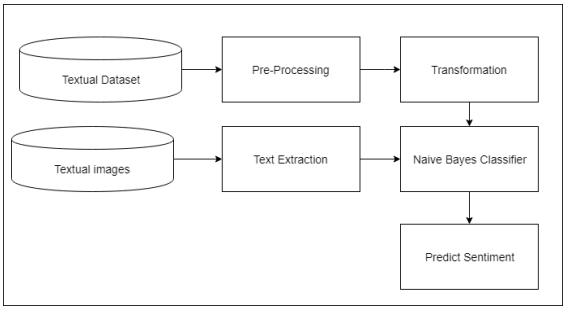

Fig. 2 Block diagram for sentiment analysis

4. Evaluation **Table 2.0** Confusion Matrix

Predicted: NO	**Predicted: YES**	
TN=643	**FP**=491	**Actual: NO**
FN=203	**TP**=1171	**Actual: YES**

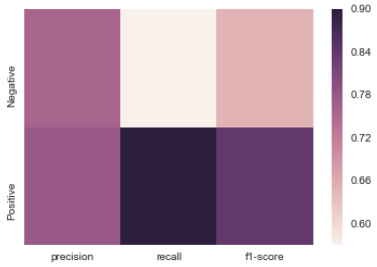

Fig.3 Heatmap for F1 Score

The Fig.3 shows the graph that displays the precision, recall and F1-score for the class labels positive and negative. The F1-score tells about the harmonic mean of precision and recall. Table 2.0 represents the confusion matrixwith TN as true negative, FP as false positive, FN as false negative and TP as true positive.

5. Conclusion

A novel approach for the sentiment analysis of text-based images has been developed. In the proposed approach, the first step includes the extraction of text from the images by using the Tesseract module followed by performing sentiment analysis of the extracted text by the Multinomial Naïve Bayes classifier hence, finally providing sentiment value of the image.

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