Sentimental Analysis of Product Based Reviews Using Machine Learning Approaches

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Abstract **- With the fast growth of e-commerce, large number of products is sold online, and a lot more people are purchasing products online. People while buying also give feedback of product purchased in form of reviews. The user generated reviews for products and services are largely available on internet. Since information available on internet is so widespread, we need to extract the needful information for which we make use of sentimental analysis. Sentiment analysis extracts abstract and to the point information required for source materials by applying concept of Natural language processing. It is used to deal with identification and aggregation of the opinions given by the customers. These reviews play vital role in determining potential customer for the products as well as market trend for product. This paper provides summary of reviews for products by classifying these reviews as positive, negative or neutral. Information on internet is highly Since reviews are highly unstructured, machine learning approaches are applied including naïve Bayes and support vector machine algorithms by first taking inputs as unstructured product reviews, performs preprocessing, calculates polarity of reviews, extracts features on to which comments are made and also plots graph for the result. The algorithms precision, recall and accuracy are measured Finally.**

Index Terms **- Machine Learning, Semantic Orientation, Sentiment Analysis, Support Vector Machine, Naïve Bayes.**

1.INTRODUCTION

In past days, purchasing of products was more based on getting product review from nearby neighbors, relatives etc. as products were purchased directly from merchants. People believed relatives, and friends review about product helpful. But with change in technology, we saw development of Ecommerce industry with sites flooded by products from different brands made available to customers at the touch of one click. The availability of product-based sites with doorstep delivery has made it convenient for customers to shop online. It provides one stop shop for all needs of customers. With so much change in shopping pattern, we see merchants providing customers with feedback option about the product. Customers write reviews from all parts of the world. There are thousands, millions of reviews being written. So a question arises on how to get fundamental judgment about product without going through each of them separately. A lot of reviews are very long, making it difficult for a potential customer to review them to make an informed decision on whether the customer should purchase the product or not. A vast number of reviews also make it difficult for product manufacturers to keep log of customer opinions and sentiments expressed on their products and services. It thus becomes necessity to produce a summary of reviews. Summarization of reviews is done using sentiment analysis. Sentiment analysis tends to extract subjective information required for source materials by applying natural concept of natural language processing [4]. The main task lies in identifying whether the opinion stated is positive or negative. Since customers usually do not express opinions in simple manner, sometimes it becomes tedious task to judge an opinion stated. Some opinions are comparative ones while others are direct. Sentimental analysis helps customer visualize satisfaction while purchasing by simple summarization of these reviews into positive or negative- two broader classified classes. Feedbacks are mainly used for helping customers purchase online and for knowing current market trends about products which is helpful for developing market strategies by merchants. In this paper, we examine the effectiveness of applying machine learning techniques to the

sentiment classification problem. Machine learning is divided into: supervised and unsupervised approaches [1]. Supervised learning tends to be more accurate because each of the classifiers is trained on a collection of representative data known as corpus in contrast to unsupervised learning which does not require prior training. In order to mine the data instead; it measures how far a word is inclined towards positive and negative. To understand sentiment analysis this paper focuses on supervised machine learning approaches. The rest of the paper is organized as follows. Second section discusses in brief about the work carried out for sentiment analysis in different domain by various researchers. Third section is about the approach we followed for sentiment analysis. Section four is about implementation details and results followed by conclusion and future work discussion in the last section

2. LITERATURE SURVEY

Many researchers have worked in the field of sentiment analysis, each one proposing new way of getting better efficiency from machine learning approaches. A LSA to identify product feature opinion words which are required to choose correct sentences to become a summarization of review, with allowing only selected features to show the end results, thereby, reducing actual size of summary [1]. In [2] author talks about the specific problems within sentiment analysis field which includes document level, sentence level, feature level, comparative opinion and sentiment lexicon problem. Bo pang [4] considers classifying documents not by topic, but by overall sentiment, concluding whether a review is positive or negative. Reviews are converted to simple decision by making use of approaches such as naïve bayes, support vector machine by initially counting the number of positive and negative words in a document. Since opinions are not always direct e.g. “the Nokia phone is good” but also it can be a comparative opinion like “Nokia phone has better battery life than Samsung”. There exists three levels at which opinions are classified: sentence level, document level, and feature level [8]. At sentence level, subjective and objective opinions exist, at document level, a document is classified based on overall sentiment expressed by opinion holder. However, at feature level, attributes of products are taken into consideration, which provides classification in depth. In paper [5], a holistic lexicon-based approach is proposed that allows the system to handle opinion words that are context dependent. It takes into account the counting of the number of positive and negative opinion words near the product feature in each sentence. If count of positive opinion words are more than that of negative opinion words, the final prediction on the feature is positive else negative. Author in [6] makes use of higher n-gram model using three classifiers. The first one being language model which is a generative method that computes the probability of generation of a word sequence. The Passive-Aggressive algorithms are second which consists of a family of margin based online learning algorithms for binary classification. Third, to predict the polarity of a review. Apart from classifying reviews in two broader categories, there also exists a term polarity degree to measure the strength of opinions, as in is the opinion strongly positive, mildly positive, highly negative etc [8]. Author in [9] says product of sentiment value and occurring frequency gives measurement of sentiments. Psenti approach calculates the overall sentiment of stated opinionated text like customer reviews and scales them as a real score between -1 and +1, which can then be easily transformed positive/negative classification or into a scale of 1-5 stars. Creating candidate list using POS tagging with removal of stop word leads to aspect identification. The aspect having less than 5 comments on it, is removed from the candidate list. In paper [10], the product review is translated into a Vector of Feature Intensities (VFI). A VFI is a vector of N+ 1 value, each one representing a different product feature and the other features. Snyder and Barzilay [11] addressed the problem of analyzing multiple related opinions in a text and presented an algorithm that jointly learns ranking models for individual aspects by modeling the dependencies between assigned ranks. Tabular comparison of various existing approaches is shown in table1

3. PROPOSED SYSTEM

The approach involves use of collection of product-based dataset from different E-commerce sites like amazon.com, epinion.com etc. The reviews are collected on products like phone, iPod etc. The objective of the work is to analyze and predict product-based reviews by classifying them as positive, negative and neutral by using algorithms like naïve

baye's and SVM. Since input is about product reviews that are unstructured, we perform pre-processing, extracts features on to which comments are made, then calculates polarity of reviews, and also plots graph for the result. The results also cover dealing with negation part. For example- "the Nokia phone is not bad" gives positive review though it contains a negative word "not". The flow diagram for approach is as given below and subsections are explained in details in next subsections.

Dataset

The dataset was collected from different product sites related to mobile domain product reviews like .cnet.com, downlaod.com, reviewcentre.com, zdnet.com, epinions.com and consumereview.com.

Pre-processing

The dataset is unstructured; it may contain repetitive words, large number of words that are not at all needed in summarizing of opinions. Pre-processing involves removal of stop words such as 'and', 'or', 'that' etc. followed by porter stemming which involves simplifying target words to base words by removal of suffixes such as – ed, ate, ion, ional, ment, ator, ssess, es, ance or conversion from ator to ate etc. For example, "replacement" is stemmed to replac; "troubled" to trouble ; "happy" to happi ; "operator" to operate. The raw data is pre-processed to improve quality.

Feature Extraction

Features in reviews are extracted so that it helps customer to know which feature has positive comment and which one has negative. Since overall conclusion about product is much needed but there is also situation where customer requirements come into the scenario. Use of adjectives is done to classify opinions as positive or negative using unigram model. For example, "the Samsung camera I bought was good; it has got great touch screen, awesome flashlight." The feature extracted out of it would be like:

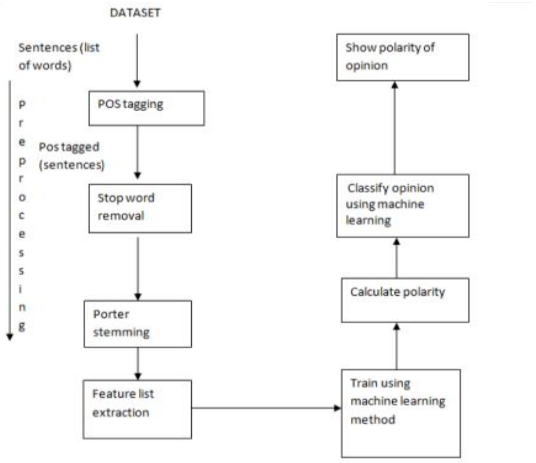
Domain:
Mobile; Product: Samsung; Feature: Camera; Adjective: Good.

Training and classification

Supervised learning generates a function which maps inputs to desired outputs also called as labels because they are training examples labeled by human experts. We apply naïve bayes and support vector machine techniques to carry out supervised
learning on the dataset fetched.

4. SYSTEM DESIGN

ARCHITECTURE DESIGN:



Naïve bayes:

Naive Bayes classifiers work on the principle that the value of a particular feature is independent of the value of any other feature. For example- Samsung phone will be considered as phone if it has basic call function, touch screen and camera. A naive Bayes classifier considers each of these features to contribute independently to the probability that this Samsung phone is a mobile, regardless of any possible correlations between the cameras, call function and touch screen. Assign to a given document d a, the class c * = arg maxc P(c | d)

Support Vector Machine:

Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier. Every data represented as a vector is classified in a particular class. Now the task is to find a margin between two classes that is far from any document. The distance defines the margin of the classifier, maximizing the margin reduces indecisive decisions. SVM also supports classification and regression which are useful

for statistical learning theory, and it helps recognizing the factors precisely, that needs to be taken into account, to understand it successfully.

Implementation:
We use Microsoft visual studio as platform to develop an interface where we could test and train datasets, extract features out of it, choose a classifier Naïve bayes or Support vector machine to work upon and thus predict polarity of opinion at the end. Overall we have used files extracted from E-commerce datasets for testing and training both. The dataset used has total size of 13094 product reviews out of which 12094 are used for training and 1000 are used for testing. For training flow is as follows as depicted. The pseudo code for process is as shown: Input- Dataset of product reviews Output- Classification of these reviews as positive and negative.
Step1: Preprocess the data
Removal of special characters
Removal of stop words
Stemming the word

Step2: Get feature list
If word in stop word list
Removal word
Return file
Else append word to file

Step3: Extract feature list
Match every word in pre processed list
If word matches adjective in base list
Display word
If word matches feature in base list
Display feature

Step4: combine both feature and preprocessed list
Step5: Use machine learning algorithms
Compute probability
Step6: classify opinion as positive, negative or neutral

5. RESULTS

Sentiment Analysis of Customer Product Reviews Using Machine Learning
In this project author is detecting sentiments from amazon reviews by using various machine learning algorithms such as SVM, Decision Tree and Naïve Bayes. In all 3 algorithms SVM is giving better accuracy and to train this algorithms author has used AMAZON reviews dataset and this dataset is saved inside 'Amazon_Reviews_dataset' folder. Below screen shot show example reviews from dataset
In above dataset first row contains column names and remaining rows contains dataset values and in above dataset first column contains sentiment values from 1 to 5 and its associated with each review and we will use above dataset to train all 3 machine learning algorithms.

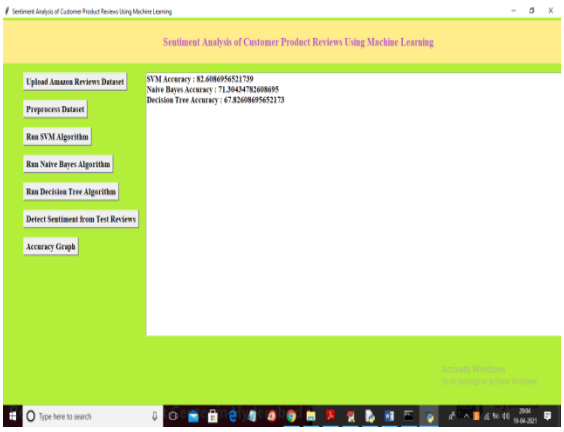
To implement this project author has used following modules

1. Data Collection: Using this module we will upload AMAZON reviews dataset to application
2. Data Preprocessing: using this module we will read all reviews and then remove stop words, special symbols, punctuation and numeric data from all reviews and after applying Preprocessing we will extract features from all reviews.
3. Features Extraction: here we will apply TF-IDF (term frequency Inverse Document Frequency) algorithm to convert string reviews into numeric vector. Each word count will be put in vector in place of words.
4. Run SVM Algorithm: We will apply SVM algorithm on TF-IDF vector to train SVM algorithm and then we apply test data on SVM trained model to calculate SVM prediction accuracy
5. Run Naïve Bayes Algorithm: We will apply Naïve Bayes algorithm on TF-IDF vector to train Naïve Bayes algorithm and then we apply test data on Naïve Bayes trained model to calculate Naïve Bayes prediction accuracy
6. Run Decision Tree Algorithm: We will apply Decision Tree algorithm on TF-IDF vector to train Decision Tree algorithm and then we apply test data on Decision Tree trained model to calculate Decision Tree prediction accuracy
7. Detect Sentiment from Test Reviews: Using this module we will upload test reviews and then ML algorithm will predict sentiment for each review and in below test reviews dataset we can see there is no sentiment value and ML will predict sentiment for each test value

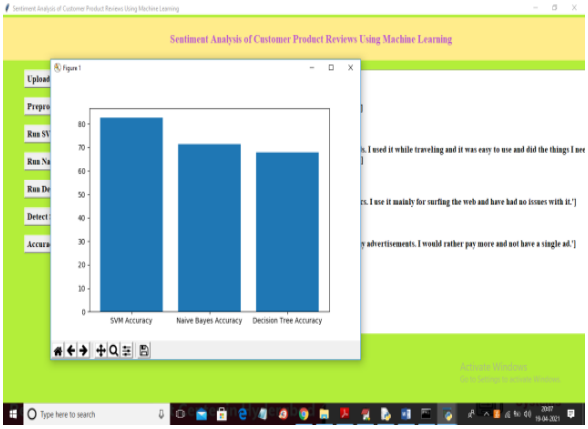
In above test data we have only test reviews and by applying ML trained model on above test data we can predict sentiment label.

SCREEN SHOTS

- To run project double click on 'run.bat' file to get below screen
- In above screen click on 'Upload Amazon Reviews Dataset' button to upload dataset
- In above screen we are selecting and uploading 'Amazon.csv' file and then click on 'Open' button to load dataset and to get below screen
- In above screen dataset loaded and now click on 'Preprocess Dataset' button to read all reviews from dataset and then apply Preprocess steps to get below screen
- In above black console we can see application read all reviews from dataset and then generate below TF-IDF vector
- In above screen in text area we can see application extract all words from reviews and then put in top line of above test area and in remaining rows if that word appear then it put average count value of that word and if word not appear then 0 will put. In above screen vector generated and I am showing few records from that vector. In that vector total reviews are 573 and all reviews contains total 2361 unique words. Now vector is ready and now click on 'Run SVM Algorithm' button to train SVM with above vector
- In above screen with SVM we got 82% accuracy and now click on Naïve Bayes and Decision tree button to get their accuracy
- In above screen with all 3 algorithms SVM gave better prediction accuracy and now click on 'Detect Sentiment from Test Reviews' button to upload test reviews
- In above screen selecting and uploading 'test.csv' file and then click on 'Open' button to get below prediction result
- In above screen first I am displaying reviews from uploaded test file and then predicting positive and negative sentiment for each review and you can scroll down above text area to get all outputs



In above screen with SVM we got 82% accuracy and now click on Naïve Bayes and Decision tree button to get their accuracy



In above screen with all 3 algorithms SVM gave better prediction accuracy and now click on 'Detect Sentiment from Test Reviews' button to upload test reviews

6. CONCLUSION

Incorporating highlights of all the equipment segments utilized have been created in it**.** in this way adding to the best working of the unit. All the modules are set in their particular places, in this way adding to the best working of the unit. Besides, utilizing profoundly propelled IC's with the assistance of developing innovation, the undertaking has been effectively implemented. Hence the paper has been designed and perfectly tested successfully.

7. FUTURE SCOPE

Sentiment analysis deals with identifying and aggregating the sentiment or opinions expressed by the users. Sentiment analysis is to classify the polarity of

text in document or sentence whether the opinion expressed is positive, negative, or neutral. We see here that two approaches have been compared and a result for both approaches respectively on the product review dataset has been done. Naïve Bayes is found to give better accuracy that is 84.02% as compared to SVM approach which is 80.2%. We see that for text files that are too large in size take much more computation time. Automatic sentimental analysis is very useful to identify and predict current and future trends.

Till now opinion at feature level has been taken up but many limitations still exist which can be further taken up.

The future scope of improvement -

- Reviewing product-based opinions in multiple languages.
- Dealing with problem of mapping slangs.
- Dealing with sarcastic opinions.
- Identifying comparative opinions and finding which among two product compared is best one.
- Dealing with anaphora resolution like what is actually being referred to in the opinion.

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