

Recommending Products to Customers using Opinion Mining of Online Product Reviews and Features

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Abstract- E-Commerce sites are gaining popularity across the world. People visit them not just to shop products but also to know the opinion of other buyers and users of products. Online customer reviews are helping consumers to decide which products to buy and also companies to understand the buying behavior of consumers. In this paper we have created a prototype web based system for recommending and comparing products sold online. We have used natural language processing to automatically read reviews and used Naïve Bayes classification to determine the polarity of reviews. We have also extracted the reviews of product features and the polarity of those features. We graphically present to the customer, the better of two products based on various criteria including the star ratings, date of review, the helpfulness score of the review and the polarity of reviews.

Keywords-Opinion Mining, Natural Language Processing, Naïve Bayes Classification

I. INTRODUCTION

E-Commerce sites pervade the internet. A wide variety of products are sold online including electronic goods, apparel and household items. With mobile phones becoming a common medium of accessing the internet, e-commerce too is gaining rapid momentum. India is one of the fastest growing E-Commerce and E-Retailing markets with the market expected to grow to around US\$ 9 billion by 2016. With such a rapid growth in this industry, companies are using sophisticated algorithms to understand the buying patterns of their buyers in order to enrich the customer experience. There is cut throat competition among E-

availability of robust machine learning algorithms and tools, companies and individuals are able to create platforms that can help to:

- Compare products based on reviews
- Compare E-Commerce sites
- Recommend Products to customers
- Make decisions on pricing and promotion of products

For individual customers, it could be a cumbersome process to read through each review of various products and make decisions. For instance, on the website of the India E-Retailing company Flipkart, recently launched Redmi 1S phone has nearly 4800 ratings and 3900 reviews. There are numerous mobile phones with very similar features and in such circumstances customers rely on the reviews of others before making a decision. Hence E-Commerce sites provide as many details of reviews as possible on their websites. While making their decision, customers look at the following aspects:

- Number of star ratings
- Positive and Negative tone of reviews
- Various features of products (eg. Battery life, RAM, screen resolution with respect to mobile phones) discussed in reviews
- Helpfulness factor of reviews
- Authenticity of reviews
- Number and age of reviews

customer reviews and offer suggestions. Each of these systems address reviews from different perspectives but what may be required is a holistic system that takes multiple aspects discussed in reviews, combine them into valuable insights and assist the customer to make decisions. In our paper we have extracted the customer reviews of popular mobile phones from www.flipkart.com. We have considered the star ratings, text reviews, helpfulness score of a review, product feature spoken about in the review and the date of the review for our analysis. We have used Natural Language Processing techniques to determine the polarity of the reviews. We have also arrived at a score for a specific product by including:

- Star Rating
- Number of Positive Reviews
- Number of Negative Reviews
- Helpfulness score of reviews
- Age of Review

We have used these scores to compare two or more products and recommend the best product to the customer.

Our paper is organized as follows. In Section II we present background information on review mining and opinion mining. We also present related works in this section. In Section III we discuss the methodology of our approach and present details of implementation in Section IV. We conclude in Section V.

II. BACKGROUND AND RELATED WORK

Social networking and e-commerce sites provide the opportunity for people to interact with each other and publicly share their opinions about other people, places, products and events. A platform is provided to express opinions quantitatively through scores, star ratings or votes as well as qualitatively through text and videos. The internet is now filled with such opinions and will serve as a "gold mine" to companies trying to understand their customers.

Opinion mining is rapidly evolving research area with newer and newer technologies and algorithms enabling the automatic processing of data. Opinion mining is the study of people's sentiments and opinions about objects and the various aspects of the objects [1]. Opinion mining has several applications, some of which include:

- Understanding the attitudes and sentiments of people on social networks like facebook and twitter

launch of high technology gadgets and during natural disasters. Before the advent of computational algorithms for mining and natural language processing, such sentiment analysis was done manually where researchers did a content analysis or a discourse analysis of the opinions, manually classified them and analyzed the results using pure statistical analysis. With more and more advanced tools being developed by the machine learning community, opinion mining has become a rapidly evolving domain where large amount of public opinion data can now be analyzed computationally.

Wang et al have proposed a system for twitter sentiment analysis of 2012 US Presidential Election [2]. Balahur et al have done opinion mining of news paper quotations [3]. Pak and Paroubek perform a linguistic analysis of twitter messages [4]. Bollen et al in [5] have studied the impact of public mood on the stock market prices. These works show that sentiment analysis finds application in a wide variety of domains.

In the specific context of opinion mining being used for mining of customer reviews on e-commerce sites, two types of parameters are considered.

- The objective parameters which include number of star ratings, number of reviews, the age of reviews etc
- The subjective parameters which include the emotions of reviewers while expressing their opinion about a product and the specific feature of the product about which they are talking

While the objective parameters can be factored in using numerical calculations, studying the subjective parameters need natural language processing (NLP) techniques to tell if the opinion expressed by the reviewer is positive or negative. NLP techniques also help in extracting the portions of reviews where reviewers talk about specific product features like battery life or screen resolution in the context of mobile phones.

In generic terms, mining of online customer reviews involve the following steps:

- Automatic extraction of review components from e-commerce sites
- Natural Language Processing of text reviews Classifying reviews as positive or negative based on the adjectives used
- Identifying and extracting product features mentioned in the text reviews
- Extracting the opinion expressed about the

have done an analysis of more than 1500 reviews on Amazon and concluded that the depth of the review, product type and extremity of the review have an impact on the perceived helpfulness of a review [8]. A product feature based ranking has been done by Zhang and Narayanan in [9] and by authors of [10] and [11]. Challenges for developing tools for opinion mining have been highlighted in [12]. Zhang et al have proposed a product ranking model for SLR camera and TV reviews on Amazon website [13]. Zhan et al have adopted a review summarization approach in [14]. Dave et al have done a semantic classification of reviews in [15]. A co-occurrence association based method for fine grained review mining has been proposed in [16]. A detailed survey of opinion mining literature has been presented in [17].

III. METHODOLOGY

We have adopted the following methodology to perform opinion mining of customer reviews.

Step 1: Choosing the e-commerce site: We had to choose between Amazon and Flipkart. In the Indian context, Flipkart ranks better than Amazon and also several products had more number of reviews on Flipkart than on Amazon. Hence we chose Flipkart.

Step 2: Choosing mobile as the product: Recently Flipkart made big news by launching phones like Xiaomi Mi 3 exclusively on their site. This attracted more reviews and ratings. Mobile phones are one of the most viewed and sold products on e-commerce sites.

Step 3: Extracting reviews: We extracted star ratings, date of review, and text of the review and helpfulness score of each review from Flipkart.

Step 4: Processing Reviews: Natural language processing of the reviews was done and based on their content they were classified as positive or negative reviews.

Step 5. Product feature identification: The contents of each review was analyzed to extract the mention of product features and if the review about that feature was positive or negative.

Step 6: Quantitative analysis: A count of the star ratings was taken and average was calculated. The number of positive and negative reviews was counted. Feature based pros and cons were counted.

Step 7: Product Score: Based on the rating, polarity of reviews, date and helpfulness of reviews, we calculated a product score.

Step 8: Recommendation to users: A summary of

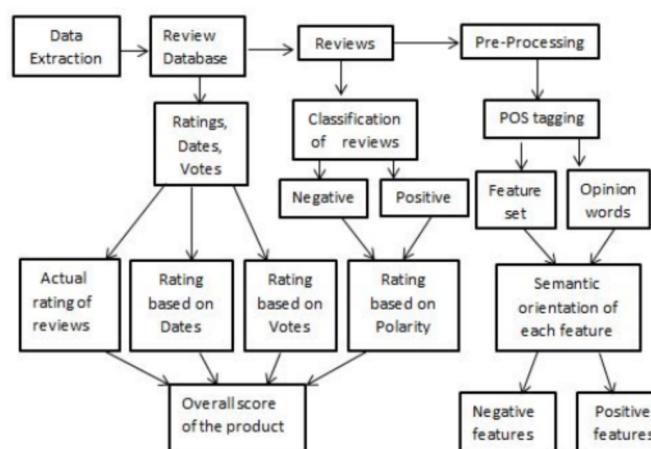


Fig 1. Opinion Mining Methodology

IV. IMPLEMENTATION

In this section, we discuss in detail the methodology adopted to perform opinion mining on customer reviews of mobile phones on flipkart. We exclusively focus on those steps that involved computational tools and algorithms.

- 1. Extracting Reviews:** There are several tools available for extracting reviews automatically from websites. Some of them are VisualWeb Ripper, Scrapy, Handy Extractor, Helium Scraper etc. We used our own python code to extract reviews. We extracted a total of 1039 reviews for Samsung Galaxy Duos 2 from Flipkart. The reviews are ordered in the following manner.

Table 1: Sample Extracted Review

Star Rating	5
Review	I bought this phone 3 days back. Also bought SanDisk SDSQQUA-016G-U46A 16 GB Memory Card. This phone is amazing. The reason I bought this phone is simple: 1. I want good after sale services.2. Wanted a phone for casual/durable use. (Even if it drop 2-3 time - Nothing should....)
Date	23 Dec 2013
Votes	88-49

the review. Naïve Bayes Classifier was used to determine the polarity of the reviews.

3. Feature Extraction from Reviews: When customers write reviews of products, most of them focus on specific aspect of the product. For example, "Screen Resolution is poor", "Battery drains too fast" or "Excellent audio quality" are some reviews commonly written for mobile phones. Hence it is not just important to get an overall idea of the review but also to understand what features customers are satisfied with and what features make customers unhappy. This feature based extraction is of immense benefit to both customers and sellers who are looking for making improvements to the products as well as marketing strategies. We used the "MALLET" for this purpose. Mallet is a package mainly used for NLP. Mallet finds applications in a number of areas including document classification, topic modeling etc. Topic models are useful for analyzing large collections of unlabeled text. The MALLET topic modeling toolkit contains efficient, sampling-based implementations of Latent Dirichlet Allocation, Pachinko Allocation, and Hierarchical LDA. We used Mallet to identify those sentences that had specific features of mobile phones. Those sentences were extracted and processed for negativity and positivity. Some features that we used are "battery", "RAM", "Screen Size", "Screen Resolution", "Processor Speed" etc. Once the features are extracted, a graph is generated depicting the count of positive and negative reviews about a specific feature. The results are shown in Figure 2 and 3.

$$SF_n = SRA + PR + RPM + HAS$$

0	2.5	charger india nsn deal talk rate specification
1	2.5	flipkart phones heat user video quality wifi no
2	2.5	smartphone hangs nah resolved higher sharp grap
3	2.5	free internet specs delivered feature network r
4	2.5	battery time app heavy lot bit price bad sansun
5	2.5	processor give poor smooth features full find d
6	2.5	power replacement face beat lagging inbuilt per
7	2.5	hope hrs calling making list real apple multita
8	2.5	expected response complaining segment guess cou
9	2.5	nobile low front backup phone interface company
10	2.5	camere miui issue management money heated charg
11	2.5	heating device xiaomi heats play range review r
12	2.5	recommend ordered quad power add iron iphone pr

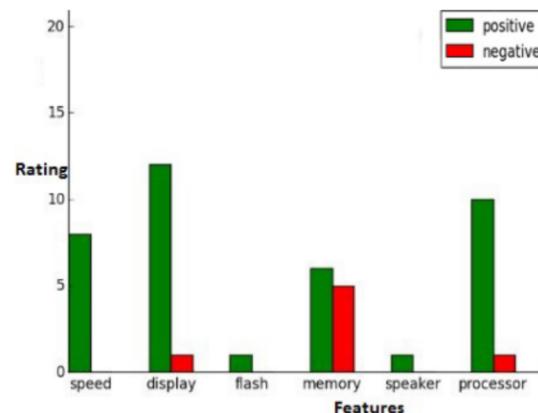


Fig.3. Graphical representation of feature based Polarity counts.

4. Product Score Classification: We have used the star ratings, polarity of the reviews, age of the review and helpfulness score of the review for calculating the score for a product.

a) For the star ratings, we calculated the average. This is the star ratings average: SRA .
 b) For the polarity of the reviews, we subtracted the total number of negative reviews from the total number of positive reviews. This polarity is then divided by the total number of reviews to include in the product score. This is included as the polarity rating: PR .

c) For the age of the review , we calculate the difference between date of first review and date of last review . We then divide the total number of reviews by the number of months of reviews . This will give us the reviews per month . A product with higher number of reviews is rated higher considering that more number of people are expressing opinion about it positive or negative. This value is added up as Review per Month: RPM .

d) For the helpfulness score, we count the number of "yes" for the "was this review helpful" question on flipkart. A average of the helpfulness scores is taken. We take this as Helpfulness Score Average: HSA .
 e) The values are summed up to give the score

5. Product Comparison : Based on the product scores as well as the polarity of feature reviews.

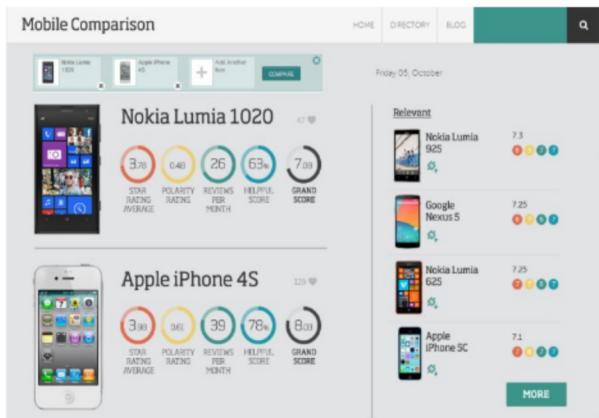


Fig.4. Comparison of 2 Products

V. CONCLUSION AND FUTURE WORK

In this paper we have presented our work on opinion mining of mobile phone reviews on E-commerce site : Flipkart. We have also done a feature based classification of reviews. The objective is to benefit the customers and assist them in choosing the right product. As future work we propose to offer a summary of reviews for more than 2 products and also automatically rank products based on the features that the user is interested in.

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