IDENTIFYING FEATURES IN OPINION MINING FOR SENTIMENT SUMMARIZATION

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Abstract

The E-commerce application contains opinion mining are the process of brings out the emotions of the public. The customer opinions are composed through the Online Shopping websites such as Amazon, Flip kart etc., and the opinion mining are positive or negative using Word-Alignment Model. Now-a-days the most emphasized subjects are under opinion mining and some of the controlling this approaches are duplicate comments. The recommendations and opinion in review sites are used for marketing and give the mindfulness to individual people. The peoples can feel free to share their attitudes, ideas, suggestion whether it may be positive or negative. The purpose of the work is to increase the accuracy of the result in manufactured goods review through this give quality of product to millions of peoples and also predict the online customer preference and also gives the survey rating to the product. This paper mainly focuses on review sites and analyzes the opinion target and opinion word extractions are not new tasks in opinion mining based on Clustering based on Frequent Word Sequences (CFWS) algorithm. There is an important determination absorbed on these tasks. They can be separated into two categories: sentence-level extraction and corpus level extraction according to their extraction aims. The experimental results show that this approach method improves performance over the traditional methods.

Index Terms— *Opinion mining, opinion targets extraction, opinion words extraction, sentiment analysis, precision classifier.*

I. INTRODUCTION

IN recent times, a numeral of online shopping customers has considerably greater than before due to the rapid growth of e-commerce, and the add two of online merchants. To improve the customer pleasure, merchants and product manufacturers allow customers to review or articulate their opinions on the products or services. [1] The consumers can now post review at the commercial sites, e.g., amazon.com, cnet.com, and epinions.com. These online purchaser reviews, thereafter, turn out to be a cognitive foundation of information which is very useful for both possible consumers and product producer.
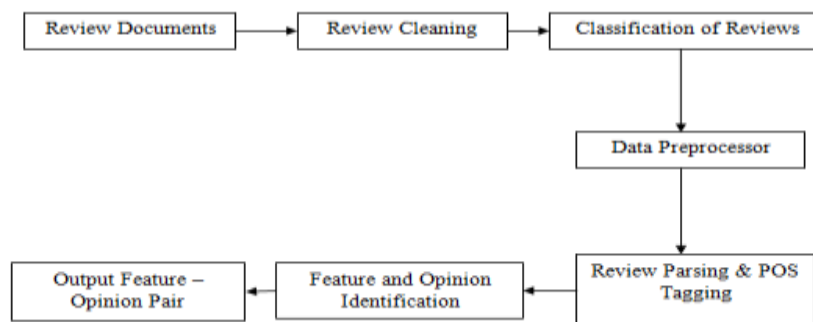

Fig 1.1 Opinion Mining System Processing

I.   PROCEDURES FOR PAPER SUBMISSION

A.   Review Stage

  Please check with your editor on whether to submit your manuscript as hard copy or electronically for review. If hard copy, submit photocopies such that only one column appears per page. This will give your referees plenty of room to write comments. Send the number of copies specified by your editor (typically four). If submitted electronically, find out if your editor prefers submissions o

  For product producer perspective, [3] considerate the preferences of clients are highly priceless for product improvement, advertising and consumer association management. Since client feedbacks manipulate other customer's decision, the appraisal documents have become a significant this approach of in sequence for big business society to take it improvement plans.

      Among the 2 main category of textual in sequence - facts and estimation, a most important segment of current in sequence processes methods such as web investigate and manuscript mining work with the former. Opinion withdrawal refers to the broad area of ordinary language processing, working out linguistics and text mining connecting the working out learning of opinions, emotion and emotions articulated in text. A thought, view, or approach based on emotion as an alternative of cause is often referred to as an emotion. Hence, an alternating term for Opinion Mining, explicitly Sentiment Analysis. This field ends dangerous use in areas where institute or individuals wish to know the common sentiment connected to an exacting entity - be it manufactured goods, human being, community policy, movie or even an institute. Opinion mining has many purpose area including [6] science and equipment, amusement, learning, political affairs, advertising, secretarial, law, investigate and development.

      In previous days, with limited admission to user produce opinions, research in this field was negligible. But with the remarkable enlargement of the World Wide Web, huge volumes of intolerant texts in the form of blogs, appraisal, discussion groups and discussion are obtainable for examination manufacture the World Wide Web the greatest, most wide-ranging and without difficulty reached intermediate for emotion analysis. On the other hand, pronouncement opinion foundation [4] and scrutinize them over the Web can be a redoubtable task because a large number of an assortment of this approaches exist on the Web and each foundation also contains a huge quantity of in sequence. From a human's point of view, it is both difficult and annoying to find suitable this approaches, extract significant criticism, read them, recapitulate them and organize them into functional form. A mechanized and faster opinion mining and abbreviation system is thus required.

Data Mining and the Web

      With the large amount of information available online, the Web is a fertile area for data mining and knowledge discovery. In Web mining, data can be collected at the

Web content mining describes the discovery of useful information from the web contents/data's/documents. Essentially, the web content data consists of data the web page was designed to convey the users, including text, image, audio, video, metadata, and hyperlinks.

Web structure mining tries to find out the model of underlying the link structures of the Web. Intra-page structure information are includes the arrangement of the various HTML or XML tags within a given page, while inter-page structure information is hyper-links linking one page to the another. This model can be used to categorize the web pages and is useful to generate information such as the similarity and association among the Web sites.

Web usage mining (also referred to as click-stream analysis) is the process of applying data mining techniques to find out the usage patterns from Web data, and is targeted towards applications. It tries to make logic of the data generated by the Web surfer's sessions or behaviors. While the web content and structure mining is use the real or primary data on the web, web usage mining mines the secondary data derived from the communications of the users during Web sessions. Web usage data includes the data from web server access the logs, browser logs, user profiles, registration data, user sessions or transactions, cookies, user queries, mouse clicks, and any other data as the result of communication with the Web.

      Given its application potential, particularly in terms of electronic trade, interest in web usage mining, increased rapidly in both the research and practice communities. It will provide a high level overview of the web usage mining process.

      Three main tasks are performed in web usage mining; preprocessing, pattern discovery, and the pattern analysis.

      Preprocessing consists of converting the usage, content, and structure contained in the various accessible data sources into the data abstractions necessary for pattern discovery. It is usually most difficult task in the web usage mining process due to the incompleteness of the accessible data.

      Pattern discovery draws upon the methods and algorithms developed from several fields such as statistics, data mining, machine learning and pattern recognition The methods and algorithms are similar to those developed for non-Web domains such as statistical analysis, clustering, and classification, but those methods are must take into consideration of the different kinds of data abstractions and the prior knowledge available for Web Mining. For example, in association rule discovery, the notion of a transaction for market-basket analysis does not take into consideration of the order in which items are selected. However, in Web Usage Mining, a server session is an ordered sequence of the pages requested by a user.

Pattern analysis is the final step in the overall Web Usage mining process. The motivation behind pattern examination is to filter out the uninteresting rules or patterns from the dataset found in the prototype discovery phase. The exact methodology is used for analysis is regularly governed by the application for which the Web mining is to be done. The most common form of pattern analysis consists of knowledge query mechanism is such as SQL. Another method is to load usage data into a data cube to perform OLAP operations. The Visualization techniques, such as graphing patterns or assigning colors to different values, can highlight patterns. The content and structure information can be used to filter out patterns of which contain the pages of a certain user type or content, or pages that match a certain hyperlink structure.

Despite being a affluent source for data mining, the Web poses challenges for efficient resource and the knowledge discovery predominantly in terms of data collection. The Web seems to be too huge for the efficient data warehousing and data mining. Also, Web pages are complex and lack unifying structure. The extremely dynamic nature of the Web as an information source poses challenges as well.

In this part of human intelligence we have to build blogs and have to send the reviews of the users dynamically. Any users can post the reviews in blogs and it will be an open source and the knowledge can be easily shared. The related work we need here is to collect all the data, related to the movie databases and also it should be updated regularly so that all the people can post the reviews and it makes the sales concert to predict easily. Here can set the reviews date and time and it became as a factor for the predicting the past sales performance too.

The aspect-level sentiment analysis on the other hand assumes that a document contains opinion about multiple aspects/entities of one or more stuff in the document. It is therefore necessary to recognize about which entity is an opinion is directed at.
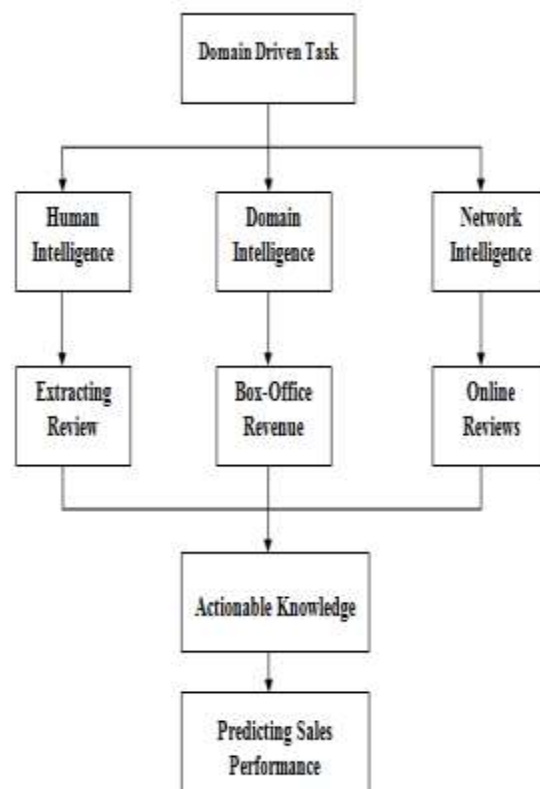

Fig1.2 Overall Process

Overview

This approach effort is partially based [8] on and closely connected to opinion mining and prison term sentiment categorization. Extensive research has been done on sentiment investigation of appraisal text and subjectivity analysis (formative whether a judgment is prejudiced or objective). Another related area is characteristic/topic-based emotion analysis, in which opinions on exacting attributes of a product are strong-minded. Most of this work contemplates on finding the sentiment connected with a sentence (and in some cases, the entire review). Here has also been some research on repeatedly extracting product facial appearance from review text. Though there has been a quantity of work in appraisal summarization, and assigning outline scores to goods based on customer reviews, there has been comparatively little work on position products using consumer examination.

<center>II. EXISTING APPROACH</center>

Preceding Systems on feature-based opinion mining have functional various processes for characteristic extraction and improvement, including Natural Language Processing (NLP) [8] and statistical methods. Though, this investigation discovered two main problems. First, most classification select the feature from a sentence by allowing for only information about the term itself, for example, term regularity, not inconvenience to consider the association among the term and the related opinion expression in the sentence. As a result, [5] there is a high likelihood that the wrong conditions will be selected as features. Following, words similar to 'photo,' 'picture,' and 'image' that include the same or similar denotation are treated as dissimilar features since most methods only employ outside or grammatical investigation for feature discrimination. This results in the removal of too numerous features from the review data, often foundation erroneous opinion analysis and providing an unsuitable summing up of the appraisal investigation.

Level of Opinion Mining

The opinion mining responsibilities at hand can be generally confidential based on the point, at which it is done with the a variety of levels being specifically,

- The manuscript level,

- The sentence level and

- The feature level.

At the manuscript level, sentiment classification of credentials into optimistic, pessimistic, and unbiased polarities is done with the postulation made that each document focuses on a single object O(although this is not unavoidably the case in many pragmatic situations such as discussion forum posts) and contains estimation from a particular opinion holder. At the sentence level, [3] recognition of subjective or prejudiced condemnation amongst the quantity is done by classifying data into meaning (be deficient of opinion) and prejudiced or opinionated text. Consequently, emotion categorization of the aforementioned sentences is done moving each condemnation into optimistic, pessimistic [6] and dispassionate classes. At this level as well, I make the hypothesis that a stretch be full of only estimation which as in this approach preceding levels is not true in many cases. A non obligatory task is to think about phrase.

At the feature level, the varieties of tasks that are appearing at are:

✓ Task1: Recognize and take out objects emotional appearance that has been observation on in each review/text.

✓ Task 2: Influential whether the estimation on the features are positive, pessimistic or neutral.

✓ Task 3: Grouping characteristic synonyms and manufacture a feature-based estimation summary of multiple reviews/text.

When in cooperation F (the set of features) as well as W (synonym of each feature) is unidentified, all three everyday jobs need to be act upon. If F is known but W is unknown, all three tasks are required, but Task 3 is easier. It tapered down to the difficulty of corresponding discovered skin tone with the set of arranged features F. At what time both W and F are known, only task 2 is wanted.

<center>III. PROPOSED APPROACH</center>

A. Sentence-Level Sentiment Analysis

The emotion classification at the manuscript -level is the most significant pasture of web opinion mining. However, for most applications, the manuscript -level is too common. For that reason it is possible to perform finer investigation at the sentence-level. The examine studies in this field mostly meeting point on a categorization of the condemnation whether they hold an purpose or a individual speech, the aim is to be familiar with subjective sentences in news piece of writing and not to remove them. The sentiment classification as it has been demonstrate in the manuscript -level part still prolong living at the sentence-level; the same come within reach of as the Turnkey's algorithm are used, based on probability ratios. Because this come surrounded by reach of has previously been demonstrate in this paper, this part meeting point on the objective/subjective sentences categorization and presents two methods to undertake this issue. The first technique is based on a bootstrapping approach using erudite patterns. It means that this process is self- humanizing and is based on expression patterns which are cultured mechanically.

Turnkey refers to incredible that is ready for instantaneous use, normally used in the sale or supply of goods or services. The word is a orientation to the fact that the customer, upon getting the product, just needs to turn the ignition key to make it prepared, or that the key just needs to be turned over to the purchaser. [1][2] Turnkey is often used to illustrate a home built on the developer's land with the developer's investment ready for the customer to move in. If a contractor constructs a "turnkey home" they structure the arrangement and finish the interior. Everything is completed down to the filing cabinet and carpet.

B. Sentence Level Extraction

Additional composite sentence-level representation is then used to remove parallel stretch pairs (or fragments). From a calculation point of view, the document-level pass through a filter steps are desirable to reduce the quantity of contestant sentence pairs. While IR performance might be useful to look up the collection accuracy, the current paper make obvious that they are not compulsory to get hold of parallel stretch pairs.

C. Sentence level Filter

The word- partly cover sprain has been put addicted to practice: for a sentence pair to be calculated equivalent the ratio of the distance end to end of the two sentences has to be less significant than two. Additionally, at least half of the terminology in each stretch has to have a transformation in the other stretch based on the word-based glossary. Here, the implementation of the exposure limitation is tightly incorporated into the above accomplishment: the decision whether objective word is together with this can be cached. Likewise, starting place speech exposure can be strong-minded by a trouble-free array look-up.

D. Methodology

The following section describes the intend of our proposed feature based on the opinion mining system based on rule-based fuzzy logic. Our proposed opinion systems automatically pull out the estimation from unstructured user reviews and classify the opinion into positive and negative opinion according to the assigned polarity. Polarity is a sometime measured as intensity. The proposed systems consist of following steps:

- ✓ Data Collection
- ✓ Data Preprocessing
- ✓ Feature and opinion generation
- ✓ Opinion Classification
- ✓ Summary

3.1. Data Collection

The first step of opinion mining is to design a dataset. Here collect the opinions from various sources. Taking reviews, blogs etc. of specified domain which is selected for analysis. Since aspect level of examination is based on the aspects so we had search different websites, magazines for the identification of aspects.

3.2. Data Preprocessing

User's opinions are generally expressed in the natural language which contains errors in spelling, grammar, mistakes in punctuations and so on. Before mining the user generated reviews need preprocessing in order to remove noise. The data preparation step performs needed data preprocessing and cleaning on the dataset for the successive analysis. Some commonly used preprocessing steps contain removing non-textual contents and markup tags (for HTML pages), and removing the information about the reviews that are not essential for sentiment analysis, such as review dates and reviewers' names.

3.3. Feature and Opinion Generation

In this step generate a feature set for opinion mining from cleaned reviews generated in the first step by using linguistic parser. Feature identification and selection is most important task of the opinion mining. There is more than one name for the equivalent aspects. For example someone use the "story of the book is good" or someone use "the storyline of the book is fantastic" but meaning of story and storyline is same. Hence also identify same synonym of the different aspects and design an aspect matrix.

3.4. Opinion Classification

In this step, the reviews are classified into the positive and negative reviews. It classifies a new user review by calculating fuzzy score. The fuzzy score is designed by using following steps. 1) Extract feature and words. 2) Identify the polarity and initial weight of the word. 3) evaluate overall score using fuzzy function.

3.5. Summary

This is the last step of system architecture. Here have generated a detailed summary of reviews according to selected features in textual as well as in graphical format. It consists of different types of graphs.
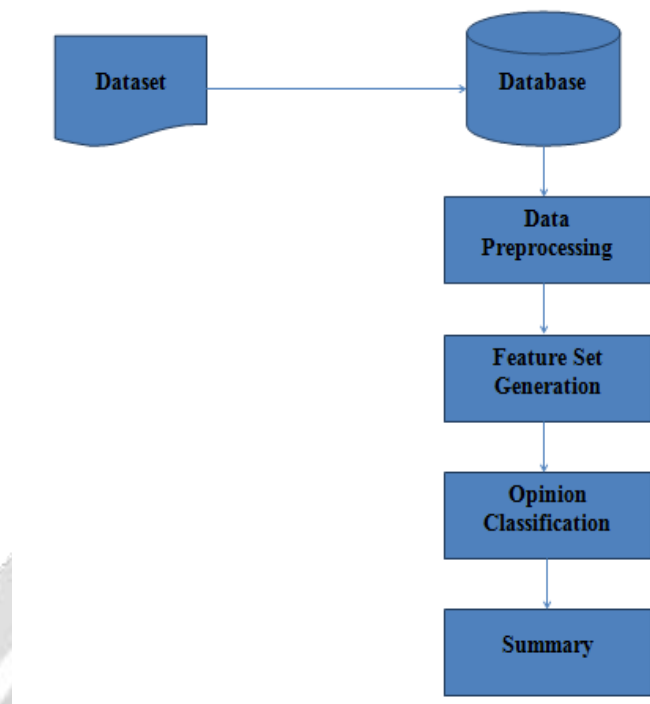
Fig 3.1 System Flow diagram

3.6. Subjective Genre Classification

Genre classification is classifies the texts into different styles, e.g., "editorial", "novel", "news", "poem" etc. Although some procedure for genre classification can be recognizing documents that express opinions, they do not tell whether the opinions are optimistic or pessimistic. In our work, need to determine whether an opinion is optimistic or pessimistic and to perform opinion classification at the sentence level rather than at the manuscript level. A more closely related work in which the authors examine sentence subjectivity classification and concludes that the presence and type of adjectives in a sentence is the investigative of whether the sentence is subjective or objective. However, their work does not deal with our specific task of the determining semantic orientations of those subjective sentences. Neither do they find out the features on which opinions have been reviewed.

3.7. Frequent Features Identification

This sub-step identifies the product features on which many people have review their opinions. Before discussing frequent feature is the identification, we first give some example sentences from some reviews to express what kinds of opinions that we will be managing. Since our system aims to find out what people like and dislike about a given product, how to locate the product features that people talk about is the critical step. However, due to the difficulty of natural language accepting, some types of sentences are hard to deal with.

3.8. Opinion Words Extraction

Now identify opinion words. These are words that are primarily used to express personal opinions. Clearly, this is related to existing work on distinguishing sentences used to express individual opinions from sentences used to objectively describe some factual information. Previous work on subjectivity has established a optimistic statistically significant correlation with the presence of adjectives. Thus the presence of adjectives is useful for predicting whether a sentence is individual, i.e., expressing an opinion. This paper uses the adjectives as opinion words. Also limit the opinion words extraction to those sentences that contain the one or more product features, as we are only concerned in customers' opinions on these product features. Let us first identify an opinion sentence.

3.9. Orientation Identification for Opinion Words

For each opinion word, we need to categorize its semantic orientation, which will be used to expect the semantic orientation of each opinion sentence. The semantic orientation of a word point out the path of that word deviates from the norm for its semantic group. The words that encode a desirable state (e.g., beautiful, awesome) have a optimistic orientation, while words that represent undesirable states have a pessimistic orientation (e.g., disappointing). While orientations apply to the many

adjectives, there are also those adjectives that have no orientation (e.g., external, digital). In this work are interested in only positive and negative orientations.

3.10. Infrequent Feature Identification

Frequent features are the "hot" features that people remark most about the agreed product. However, there are some features that only a small number of people talked about. These features can also be exciting to some potential customers and the manufacturer of the product. The question is how to extract these intermittent features (association mining is unable to identify such features)? Considering the following sentences:

"The pictures are absolutely amazing."

"The software that comes with it is amazing."

Sentences 1 and 2 share the same estimation word amazing yet describing different features: sentence 1 is about the pictures, and sentence 2 is about the software. Since one adjective word can be used to describe the different objects, we could use the opinion words to look for the features that cannot be found in the frequent feature generation step using association mining. Extract infrequent features using the procedure:

for each sentence in the review database

if (it contains no frequent feature but one or more opinion words)

{ find the nearest noun/noun phrase around the opinion word. The noun/noun phrase is stored in the feature set as an infrequent feature. }

IV. CLUSTERING BASED ON FREQUENT WORD SEQUENCES (CFWS) ALGORITHM

The idea of this approach planned algorithm is Clustering based on Frequent Word Sequences (CFWS) algorithm which is used to cluster the papers by using the perception (i.e. the words that have the same meaning) that in attendance in adequate numeral credentials. It moves toward do not regard as the credentials as bag of word but as a set of semantically related words. Proposed algorithm first generates a feature vector based on the concepts acknowledged using Word Net ontology. After produce the feature vector based on impression, utilize Apriori paradigm, considered originally for finding recurrent item sets in marketplace basket datasets, to find the recurrent impression from the characteristic vector. Then it forms the initial clusters by transmission one recurrent concept to each group. For example, CFWS created a cluster for the recurrent impression (make known, transmit, state publicly, publish) through all the documents that contain words which are either to indistinguishable or connected to this concept. The algorithm process the initial clusters makes final clusters arranged in hierarchical structure.

A. Word Net Ontology

Word Net is a great lexical catalog, a amalgamation of a vocabulary and lexicon for the English language. Word Net systematizes words into assemblage known as synsets. Each synset surround a group of one and the same words and collocations and corresponds to a concept. In adding together, each synset also surround pointers to other semantically associated synsets. Word Net catalog contains 156,854 words organized in 120,750 synsets for a total of 206,381 word-sense pairs. Word Net has this approach grouping of words - nouns, verbs, adjectives and adverbs. Surrounded by each group, the words are prepared into synsets. Each synset is identified by a unique synset number. Each word belongs to one or more synsets with each instance equivalent to dissimilar right mind of the word and is numbered according to their regularity of happening in real world usage.
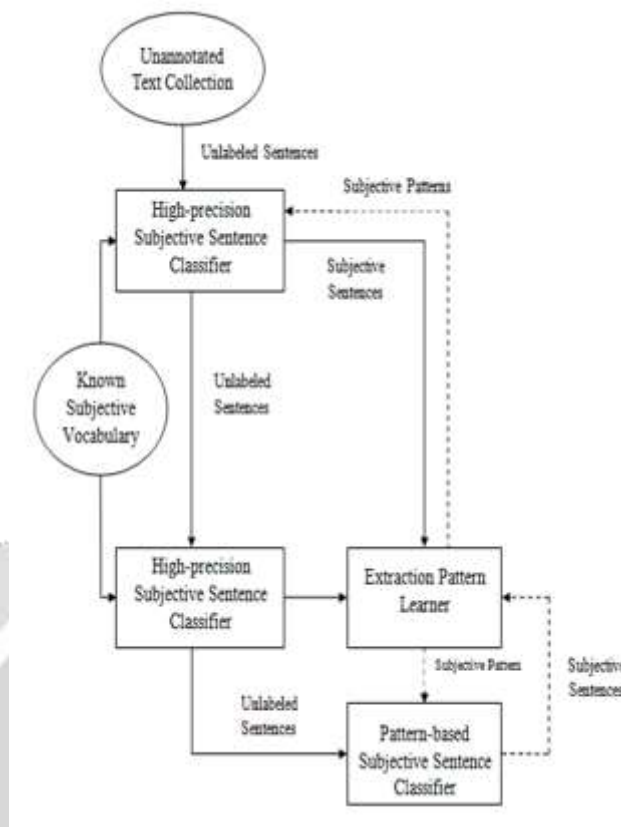
Fig 4.1 Sentence Classification

B. Document clustering

The planned document come together algorithm consists of the following phases: finding recurrent concepts, creating preliminary clusters for each frequent concept, manufacture clusters put out of place using achieve function, and building group tree. The algorithm is explained in detail as following:

Step 1: Create characteristic vectors using perception, each manuscript is represented by a vector of frequencies of perception creating by means of Word Net ontology.

Step2: Produce recurrent impression using Apriori paradigm based on entrance comprehensive sustain given by the user.

Step3: After finding the recurrent concepts now it creates the initial come together for global recurrent concepts. All credentials including recurrent concept are putting in the same come together. At this stage one manuscript can encompass few frequent concepts. If a cluster1 belongs to perception then perception 1 is the come together label for group.

Step 4: In analysis of the information that proposed algorithm is hard crowd together type so subsequently step is to make put out of place come together i.e. one manuscript can has only one group. Here it uses a score profession to make cluster Disjoint. If a manuscript belongs to more than a few clusters then calculate the score at the side of each individual cluster and dispense the manuscript to cluster that have best score among them. If there are few best groups then dispense the manuscript to the cluster that

has longest cluster label. Where: x represents the global recurrent concept in doci and the impression is also clustering frequent in Ci. x˙˙ represents a global recurrent concept in doci but the perception is not come together frequent in Ci . n(x) is the occurrence of impression in the characteristic vector of doci . n (x˙˙) is the occurrence of impression in the characteristic vector of doci .

Step 5: The chief be determined of join similar clusters in order to produce a expected topic chain of command for browsing and to increase the clustering correctness. Inter-cluster similarity is a significant term that characteristically used in both steps. Inter-cluster correspondence is the basis for amalgamation clusters.

Algorithm takes delivery of user estimation in raw form. By implement some manifestation of preprocessing in order to filter-out noise. Sentence splitting is a critical footstep in this component (opinion delimitation) since CWFS takes into account neighborhood condemnation in order to propagate sentiment. In addition in to boost the competence of the taking out development have been approved an on-line reviews.

On the added furnish, dependency tree provides connections sandwiched between distant vocabulary, which are useful in remove long detachment relations. Officially, define the confidence parsing with expression nodes as phrase enslavement

parsing. An enslavement relationship which is an asymmetric binary association holds among two phrases. One is identifying beginning, which is the innermost expression in the relation.

C. Hierarchical clustering

Hierarchical clustering (also called hierarchical cluster analysis or HCA) is a process of cluster investigation which seeks to construct a pecking order of clusters.

Divisive: This is a "top down" approach: all annotations start in one bunch, and splits are carry out recursively as one be in motion down the hierarchy.

V. EXPERIMENTS

In this paper uses multiple dataset where some of them are existing dataset and some of them are new dataset. For the implementation of Senti Word Net uses java Net beans IDE.

A. Result

Feature based opinion mining and the summarization is challenging field for the researchers. It is useful for individuals as well as for organization. There are many approaches for it. But there is no computerized technique that mines opinions that are hidden between the lines. In case of context-independent feature based on the opinion mining less work is done. For feature based opinion mining and summarization different tools like Rapid Miner, Word Net, Senti Word Net, POS Tagger, Crawlers and Parsers can be used.

Product Name		Precision (%)	ecall (%)	F1-Measure (%)
Television	Samsung	92.50	57.81	71.15
	LG	94.83	42.97	59.14
	Song	91.67	41.12	56.77
	BPL	91.43	64.00	75.22
Macro-Average		92.61	51.48	65.59

Table: Performance Evaluation of the Feature-Opinion Extraction Process.

Table recapitulates the performance measure principles for our system in the form of a misclassification matrix. The recall value is lower than the precision indicating that certain accurate feature-opinion pairs could not be recognized by the organization correctly. This is justified since most of the assessor does not follow the grammatical rules while writing reviews due to which the parser fails to assign correct POS tag and thereby correct dependency relationships flanked by word pairs. However, most of the recognized feature-concept pairs are correct, which leaves scope for enhancing our grammar to provide somewhere to stay more dependency relations.

Rank	Features	Positive Polarity Values
1	Video	578.5
2	Sound	393.0
3	Size	11.25
4	Zoom	9.25
5	Brightness	7.0

Table: Rank of the Positive Feature

Rank	Features	Positive Polarity Values
1	Lifetime	-25.875
2	Price	1-16.875
3	Warranty	-13.0

Table: Rank of the Negative Feature

The experimental study showed that the more number of features in negative list could not be extracted as most of the reviews written by the users were on the optimistic side and there were only 33 reviews which commented on the negative point on the feature size. Lifetime feature invited only 69 negative comments. The number of negative comments on Price was 79.

V. Conclusion:

Opinions are the only one of its kind type of in sequence which is dissimilar from information. Joint in sequence has spread all from side to side the Web, particularly in areas associated to everyday life, like e commerce. Regardless of important progress, however, estimation mining and sentiment investigation finding their own right to be heard as new fields. This article recommends a Supervised word alignment model, which identifying the opinion next of kin. By listening carefully on topical relations in whom product review is to extract the appropriate in sequence or skin texture only from fastidious online reviews. To conclude the items are priority based on the occurrence of optimistic and pessimistic reviews. First of all classify the condemnation as intention or prejudiced and then examine the adjectives or nouns thereby humanizing the presentation. Compared to preceding methods, this approach model captures opinion next of kin and feature withdrawal more accurately. Because of this benefit, this technique is more constructive for withdrawal of opinion target and opinion word. The intra-sentential consistency recommend that if there are other opinion words in a sentence with the considerable point of the reference, the newly establish word will get the mount up feeling of these words.

Future Enhancement

Sig-Dedup has been proposed as a future work to efficiently handle large reduplication tasks. It maps the dataset strings into a set of signatures to ensure that similar substrings result in similar signatures. The signatures are computed by means of the well-known inverted index method. Tokenization is also added to provide better understanding about the product reviews. Tokenization (providing an indexing of given products) aims at reducing the number of comparisons by grouping together pairs that share common features.

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