Sentiment Classification of Social Issues Using Contextual Valence Shifters

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Abstract- The growth of science and technology contributes in the growth of social website and electronic media at vast scale. Due to development in field of information technology, all information about anything is globally available on internet, which is great source of data and information. Data or data sets available on internet in unstructured form. To analysis the unstructured data, we need method which convert it into structured data then analyze those data. NLP, Linguistic Computation and text mining are used to analyze/extract the opinion of people from given source data (comments, blogs, feedback and reviews).

Sentiment analysis is emerged as the text analysis method, which extracts the opinion from comments, feedbacks and reviews. Sentiment Classification techniques are widely used for sentiment classification of reviews and feedbacks of customers and viewers on movie, product and services. The given feedbacks and reviews are classified into two class- positive and negative class. This paper focuses on study of negative sentences, identification of those negative sentences and calculation of sentiment score of negative sentences.

Keywords: Sentiment Analysis, Social Issues, Sentiment Classification Techniques, Negation handling.

I. INTRODUCTION

In this scientific era, any person can contact with anyone within a minute by the use of new technology i.e. video call, video conferencing, internet and social media. Data sets on internet growing at a very fast rate. Data available on internet are mostly in unstructured form of data. To retrieve the information from unstructured data need many hours to process it. Sentiment classification is a technique to classify subjective expression (sentence) into positive or negative class. Sentiment classification is widely used by manufacturing and service companies to know the emotion and feeling of people regarding any product feature, quality and service. Now a day some political parties have started to use of sentiment analysis tools, to set their manifesto and agenda for election purpose. Now, NGO and Government try to know the people opinion about any concern topic or rule before to making the policies and rules. In previous day when a person wants to purchase anything, they concern too many people about that thing before buy. But now, all people's comments and feedbacks about almost products are available on internet. They only need to analyze that feedbacks but problem is that data available in unstructured form. So, sentiment analysis tools are day by day becoming popular to extract the opinion of people from unstructured data.

As per the technical perspective, there are two main approaches for SA, such as Bag of words (BOW) and Feature Based Sentiment (FBS) [18]. In the BOW approach, the syntactic & semantic information between words are lost. So this approach is not useful in opinions mining of products & their features. While FBS approach is used for analyzing the sentiment of products & their features. Basically machine learning techniques were used for FBS and others for BOW. But all these methods classify the sentiment polarity of given documents either as positive or negative sentiment. The extensive research on automatic text analysis for sentiment, such as sentiment classifiers [13, 19, 20, 7,21], affect analysis [22, 23], automatic survey analysis [24, 21], opinion extraction [25], recommender systems [6], subjectivity detection, sentiment prediction, text analysis for opinions, extracting product features, extraction of customers opinion. This paper focuses on study of product and social issues, sentiment classification techniques, negation handling rules, calculation of sentiment orientation score of negative sentence and result analysis.

II. SENTIMENT CLASSIFICATION

The sentiment classification is presented in various formats in different domains. Positive /negative, good/bad, like/dislike, buy/don't buy, recommended/not recommended, excellent/boring (film), support/against [6]. Optimistic/pessimistic [7], favorable/unfavorable [8]. Sentiment classification done at different levels such as document level, sentence level and aspect or feature level. In document level- whole document classify either as positive or negative class. In sentence level- classifies sentence as positive, negative or neutral class. In aspect or feature level- identifying and extracting features from the opinion comments, blog, tweets and newspaper etc.

A. Subjective vs. Objective Sentences

Sentences are classified into two classes

1- Subjective and
2- Objective

```
>>>
i am con because as a student myself i see teachers focus their
teachings strictly towards what is on standardized tests.
[('i', 'PRP'), ('am', 'VBP'), ('con', 'NN'), ('because', 'IN'),
('as', 'IN'), ('a', 'DT'), ('student', 'NN'), ('myself', 'PRP'),
('i', 'PRP'), ('see', 'VBP'), ('teachers', 'NNS'), ('focus', 'NN
'), ('their', 'PRP$'), ('teachings', 'NNS'), ('strictly', 'RB'),
('towards', 'NNS'), ('what', 'WP'), ('is', 'VBZ'), ('on', 'IN'),
('standardized', 'JJ'), ('tests', 'NNS'), ('.', '.')]
('am', 'VBP')
('see', 'VBP')
1.0 Sentence Sentiment Orientation Score= 0.0
```

Figure 1:- Objective Sentence

```
>>>
standardized testing cannot improve student learning
any more than weighing a pig will fatten it!
[('standardized', 'JJ'), ('testing', 'NN'), ('can',
'MD'), ('not', 'RB'), ('improve', 'VB'), ('student',
'NN'), ('learning', 'VBG'), ('any', 'DT'), ('more',
'JJR'), ('than', 'IN'), ('weighing', 'VBG'), ('a', '
DT'), ('pig', 'NN'), ('will', 'MD'), ('fatten', 'VB'
), ('it', 'PRP'), ('!', '.')]
not
('improve', 'VB')
improve 0.375
('fatten', 'VB')
1.0 Sentence Sentiment Orientation Score= -0.375
document Score -0.375
>>>
```

Figure 2:- Subjective Sentence

Objective sentences have no sentiment. While subjective sentence have some sentiment either positive or negative. In fig. 1 there is no sentiment words, while fig. 2 show there are two words (not and improve) which reflect the sentiment of sentence. "Not" is negative word and improve is positive opinion verb (0.375), therefore "not" reverse the sentiment of sentence from positive (0.375) to negative (-0.375). We only consider the subjective sentences for sentiment analysis.

III. SENTIMENT CLASSIFICATION TECHNIQUES

Sentiment classifications techniques are mainly categorized into two categories [11].They are machine learning and lexicon based approaches. Machine learning algorithms are classified into supervised and unsupervised learning. Most of Machine learning algorithms are belongs to supervised learning which are applicable for sentiment analysis. Two sets of Data are used in machine learning: training set and a test data. Training set data/documents are used by automatic classifier to learn the differentiating characteristics of documents, while a test set is used to check how well the classifier performs [12].

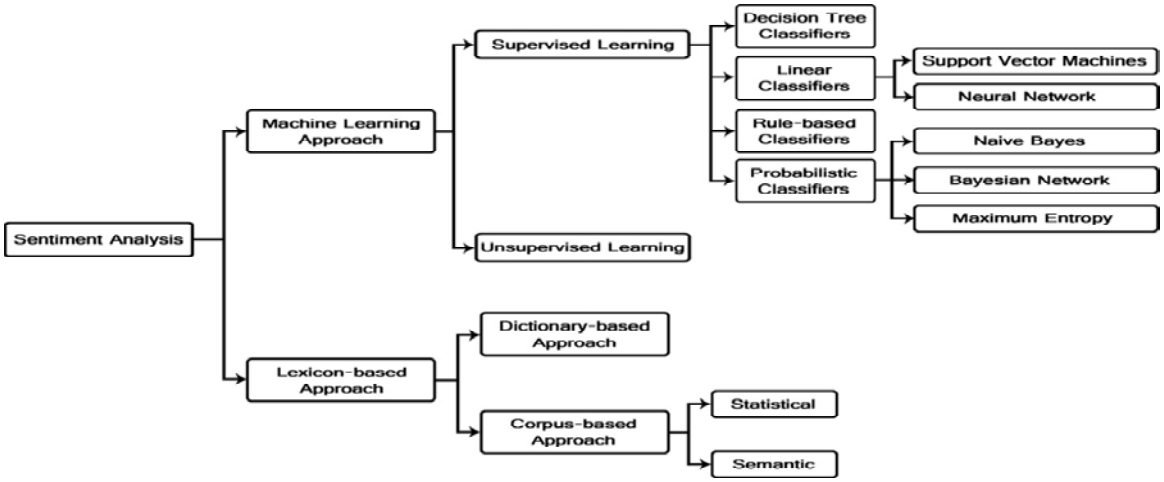

Figure 3:- Sentiment Classification Techniques [11]

A number of machine learning approaches are used to classify the reviews. These techniques are Support Vector Machines (SVM), Naïve Bayes (NB), and Maximum Entropy (ME). Machine learning approaches starts from collecting training dataset, then to train a classifier on the training data. Once a supervised classification technique is selected, then an important step: decision to make is feature selection. Then only, supervised classifier tells us how documents are represented [12].

There are some common features that are used for sentiment extraction from given opinions. They are described below-

- **Term and their frequency:-**

Terms and their frequency or presence is considered, which may be unigram or n-gram. Pang et al. [13] claimed that uni-gram given better results than the bi-gram in movie review sentiment analysis. While Dave et al. (2000) [14] claimed that tri-grams and bi-grams given better sentiment classification results for product-review.

- **POS information:-**

In POS tagging, each term in sentence will be assigned a label, which used to represent its position/role in the grammatical context. So, with POS tags, we can identify adjective and adverbs which are used as sentiment indicators [16, 15, 27].

- **Negations:-**

Negative words have potential of reversing the sentiment of opinion word (shows in fig. 2) or sentence. So we consider this feature for sentiment extraction from negative subjective sentences.

- **Opinion words and phrases:-**

The opinion words and opinion phrases are used to extract positive / negative sentiments. There are two approaches such as lexicon-based or statistical-based, are used to determine the semantic orientation of an opinion words and phrases [16]. While Hu and Lui et al. (2004) [17] used WordNet to determine the sentiment polarity of extracted adjective as positive or negative polarity.

IV. SENTIMENT ANALYSIS OF SOCIAL ISSUES

A social issue is an issue which relates to people's personal live with surrounding society, environment and culture etc. there may be as social stratification, economic issues, social disorganization, age , inequality, education and public schools, work and occupations, health and medicine, crime and the justice system and environmental racism etc. Sentiment analysis of social issues are important for government and organizations while they were making policy for the people survival along with due consideration of social factors as sentiment analysis of feedback or comments of customer on product features and services is important for company and manufacturer of product.

A. Social Issues vs Products and Services

Analyze public opinion regarding products and social issues from three aspects: feature of products and social issues, explicit/implicit mentions to products and social issues, and the distribution of various opinion terms such as adjectives, adverbs, nouns, and verbs [9].

TABLE I. Distribution of the Usage of Various Opinion Terms [9]

Parameter	Canon S100[10]	iPod [10]	Social Issue [9]
Number of Comments	110	160	100
Number of Comments	276	411	222
Usage of Adjectives	**62%**	**52%**	33%
Usage of Adverbs	17%	20%	11%
Usage of Nouns	5%	7%	9%
Usage of Verbs	16%	21%	**47%**

Above table 1 shows that in case of product review adjectives play vital role, but in case of social issues verb play vital role. From sentiment perspective, adjectives, adverbs, and nouns are considered as features when machine learning techniques are employed for sentiment analysis [9]. A verb not only has sentiment and can be considered as feature, but also affects the sentiment of other words in the sentence. Therefore, they also play a different role than adjectives, adverbs, and nouns in the sentiment of a subjective sentence [9].

V. CONTEXTUAL VALENCE SHIFTERS

The first computational model that consider for negation in a model that include knowledge of polar expression is Polanyi et. al. [2].The different types of Negation Specifying Rules are made. That rules are used to assign sentiment score to polar expression, i.e. positive scores to positive polar expression and negative scores to negative polar expression.

A. Negative and Intensifiers

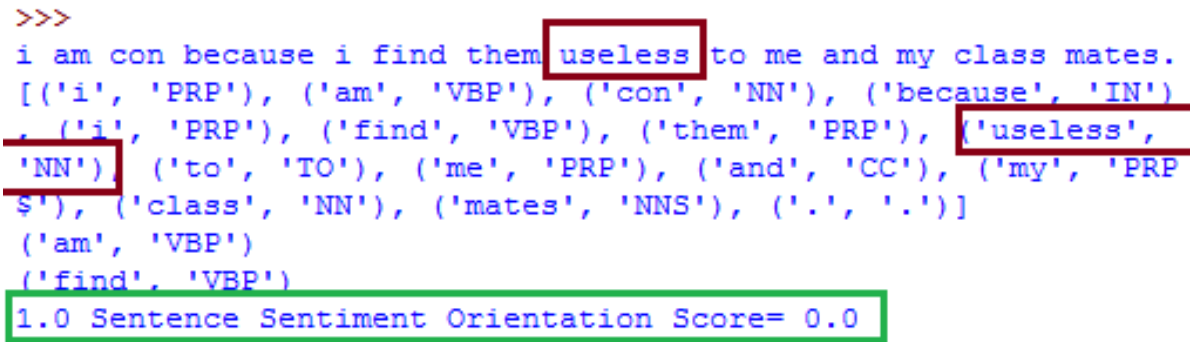

Figure 4:- "Useless" word not as Negative word

If "useless" word is not considered as negative word as shown in fig. 4, then sentiment score of the above sentence is Neutral. While sentiment of the sentence is negative due to "useless" negative word, so we consider useless as negative word.

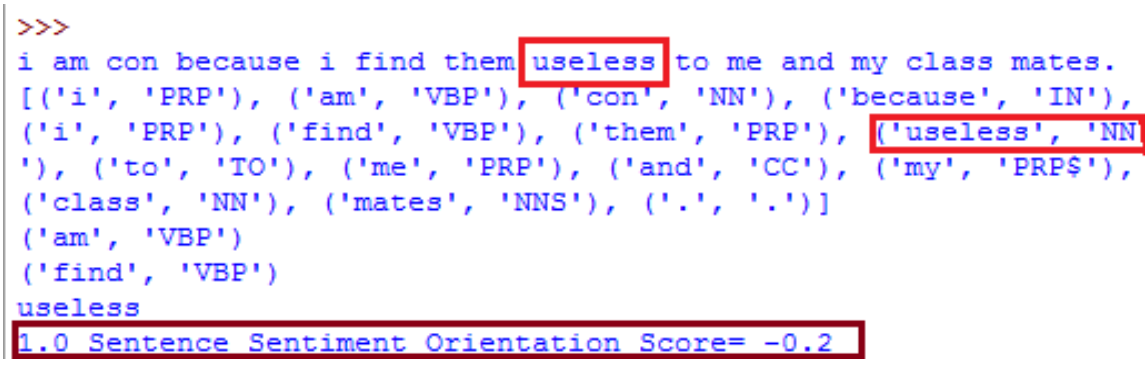

Figure 5:-"Useless" word as a Negative word

After considering "useless" as a negative word shown in fig. 5 and we fixed -0.2 as threshold sentiment orientation score for negative words , proposed method calculate the sentiment of given sentence as negative (sent_score= -0.2). There are some negative words (no, not. never, useless, without, nor, don't), which reverse the sentiment of sentence.

B. Negation Specifying Rule

To calculate the sentiment score of negative words and opinion terms along with negation words. Below table 2 shows the sentiment calculation rules of negation words. These negation rules are designed in order to improve the sentiment text analysis.

TABLE 2. Negation Specifying Rule

Negation word	Opinion verb	Sentiment score Positive/ negative	Sentiment score calculation
Yes	Positive	Negative	negative_score = negative_score – 1 * word_score
Yes	Negative	Positive	positive_score = positive_score – 1 * word_score
Yes	Verb not in dictionary	Negative	negative_score = negative_score + (-0.2)

We have applied the negation handling rule shown in above table 2 on some below examples.

1- I **like** to read science fiction.
2- I do **not like** to read science fiction.

First sentence is affirmative sentence which gives positive sentiment, while second sentence is a negative sentence which gives negative sentiment. The "not" negative word reverses the sentiment of whole sentence.

Like= sentiment score (0.8)
Not like = -1 * 0.8= -0.8
Sent_score= -0.8

3- I **hate** Mexican food.

In third sentence "hate" act as negative verb, which reflect the negative sentiment of sentence.

Hate = sentiment score (-0.75)

Sent_score= -0.75

4- I **love** Mexican food.

In fourth sentence "love" act as positive verb , which reflect the positive sentiment of sentence.

Love= sentiment score (0.5)

Sent_score= 0.5

5- I do **not hate** Mexican food.

In 5th sentence "not hate" reflects the sentiment of sentence, which is negative sentiment.

Hate= sentiment score (-0.75)

Sent_score = -1 * -0.75 =0.75

Word "not hate" is synonyms of "love". But sentiment score of "hate (0.75)" and "love (0.5)" is not equal.

VI. EXPERIMENTAL SETUP AND IMPLEMENTATION

Sentiment analysis is performed at different levels-document level, sentence level and opinion term level. To assess the impact of several approaches to sentiment negation. We proposed a basic sentence –level sentiment analysis architecture to analyze and classify the sentiment of whole document of social issues. Our approach is verb oriented sentiment classification method, which works at sentence and opinion level, in which we extract opinion verb and calculate its' sentiment score from opinion verb dictionary. Verb sentiment score is taken from SentiWordNet, and WordNet software is used to identify the opinion word as verb. The whole system process is divided into three levels and document is split into sentences. This architecture uses word-level sentiment scores in the range [-1, 1] (sentiment score may lie anywhere in between negative and positive, respectively) in order to classify the sentences into positive or negative class.

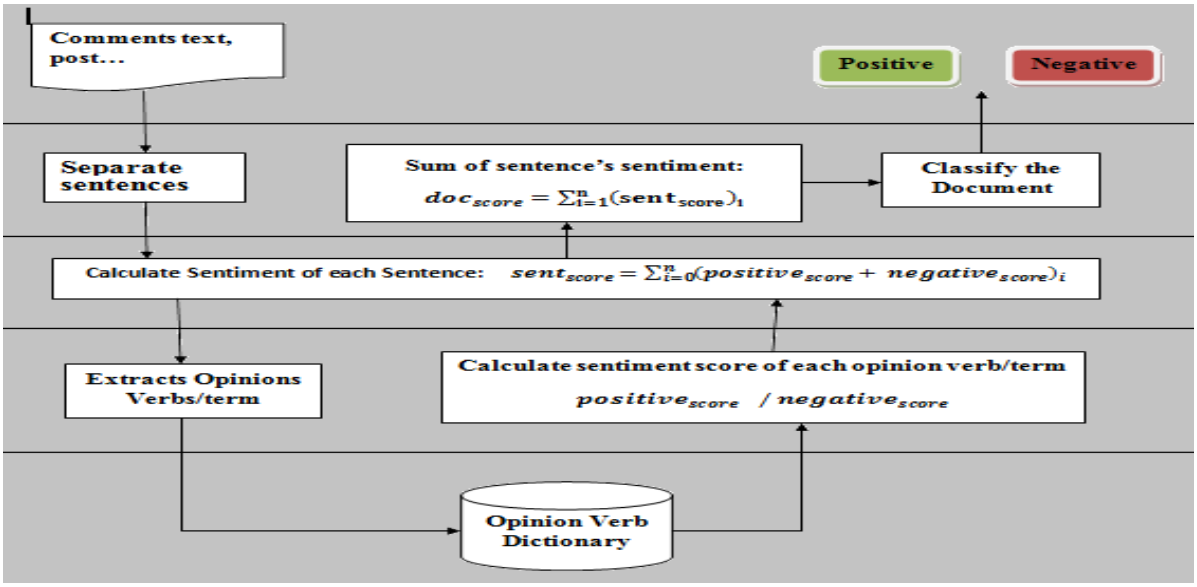

Figure 6:- Our System Architecture

A. Data Collection

- **Testing Data Set**

We collect manually comments (positive and negative) from procon.org [4].

- **Opinion verb dictionary**

Take opinion verbs from M.Karamibekr & A.A. Ghorbani [9] and add some new words. Take sentiment score value of each word from http://sentiwordnet.isti.cnr.it/ [5].

B. Tokenization

To tokenize sentence and words, we used "nltk" tool of Stanford University. If POS tagger is applied to tag parts of speech with sentence without tokenizing sentence into words. Then POS tagger tags each character with POS, which is not our desired output (figure-7).

To get our desired output first, tokenize sentence into words, then only apply POS tagger for tagging of parts of speech as shown in figure 8.

```
>>>
i like to read science fiction.
[('i', 'PRP'), (' ', 'VBP'), ('l', 'JJ'), ('i
', 'PRP'), ('k', 'VBP'), ('e', 'JJ'), (' ', '
NN'), ('t', 'NN'), ('o', 'NN'), (' ', ':'), (
'r', 'NN'), ('e', 'NN'), ('a', 'DT'), ('d', '
NN'), (' ', ':'), ('s', 'NNS'), ('c', 'VBP'),
('i', 'PRP'), ('e', 'VBP'), ('n', 'JJ'), ('c'
, 'NN'), ('e', 'NN'), (' ', ':'), ('f', 'NN')
, ('i', 'PRP'), ('c', 'VBP'), ('t', 'JJ'), ('
i', 'PRP'), ('o', 'VBP'), ('n', 'JJ'), ('.',
'.')]
(' ', 'VBP')
('k', 'VBP')
('c', 'VBP')
('e', 'VBP')
('c', 'VBP')
('o', 'VBP')
1.0 Sentence Sentiment Orientation Score= 0.0
 document Score 0.0
>>>
```

Figure 7:- POS Tagging Without Tokenization of Sentence

```
>>>
i like to read science fiction.
[('i', 'PRP'), ('like', 'VBP'), ('to', 'TO'),
('read', 'VB'), ('science', 'NN'), ('fiction'
, 'NN'), ('.', '.')]
('like', 'VBP')
like 0.8
('read', 'VB')
1.0 Sentence Sentiment Orientation Score= 0.8
 document Score 0.8
>>>
```

Figure 8:- POS Tagging after Tokenization of Sentence

C. Implementation

We have implemented this project in Python and used opinion verb dictionary as CSV format for sentiment orientation strength score extraction of verbs.

1- Read the document from folder.
2- Convert whole document into lower case.
3- Splitting the paragraph into sentence.
4- Read sentence by sentence.
5- Splitting the sentence into words.
6- POS tagging with each word by using NLTK tool Stanford University.
7- Read word by word from POS tagged sentence till word in not end.
8- Check whether word is negation word or not, if negation word, then negative= -1 and increment nflag and nword by 1.
9- Check wordtag is whether Verb or not.
10- If verb then search in verb dictionary, if verb in found in verb dictionary then fetch it corresponding values of sentiment score.
11- If 1st word is negative word and second word is verb, then multiply sentiment score of verb by -1.

If word_score < 0:
positive_score=positive_score-1*word_score
Else:
negative_score=negative_score-1* word_score

12- If 1st word is negative word but second word is verb, but not have any sentiment, then calculate only score of negative word.

negative_score=negative_score-.125

13- If second word just after negation word is not verb.

negative_score=negative_score-.125

14- If more than one negative word in same sentence then divide negative score by no. of negative words.

If nword>1:
negative_score=negative_score/nword

15- calculate Sentiment score of each sentence and print.

sent_score=positive_score + negative_score

16- Now calculate Document sentiment score.

doc_score=doc_score+sent_score

17- If document sentiment score is greater than zero then positive or if less than zero than negative sentiment.

VII. RESULT ANALYSIS

We have analyzed 48 comments, to extract the opinion of people related to social issues.

TABLE 3. Confusion Matrix

	Machine (Yes)	**Machine (No)**
Human (Yes)	t_p= 32	f_n= 7
Human (No)	f_p= 3	t_n= 6

Here "tp" repsente the number of documents classified into negative class by both.

"fn" human classified document /sentence into negative but machine classified into positive or objective class.

"fp" human classified document/sentence into positive/objective but machine into negative class.

"tn" human and machine both classified document/sentence into positive/objective class.

The following results come out after carried out our method with 38 comments on social issues.

$$\text{Precision (P)} = \frac{\text{tp}}{(\text{tp} + \text{fp})} = 91.428$$

$$\text{Recall (R)} = \frac{\text{tp}}{(\text{tp} + \text{fn})} = 82.051$$

$$\text{Accuracy (A)} = \frac{(\text{tp} + \text{tn})}{\text{tp} + \text{tn} + \text{fp} + \text{fn}} = 79.166$$

TABLE 4. Result Comparision

Author	**Approach**	**POS**	**Negation Words**	**Data Set**	**Class**	**Precision (P) %**	**Recall (R) %**	**Accuracy (A) %**
A.Kennedy et. Al. [26]	GI + CTRW + Adj.	Adjective		Product	Positive	67.1	72.9	68.6
					Negative	70.3	64.3	
				Movie	Positive	65.8	73.4	66.7
					Negative	70.0	60.1	
M. Dadvar et. al. [1]	Frequencies term	Adjective, Adverb	No, not, rather, hardly	Movie				70.0
Our method	Dictionary	Verb	nor, useless, no, never, don't, not, without, against	Social issue	Negative	91.428	82.051	79.166

We applied our method on some subjective sentences of a document to identify the negative sentence and calculate the sentiment score of document, to classify the document negative class.

In above table 4, all three methods are applied on same feature that is Parts of Speech of sentence. Two methods used adjective and adverb as feature of POS, while our method used Verb as feature of POS. Both [26, 1] other method was performed on Product or movie data set, but our method on social issues. M.Dadvar et.al. [1] used not, no, rather and hardly as negation word, while we used no, not, don't, useless, never, without, against and nor as negation words. Our result (accuracy= 79.166) is far better than A. Kennedy et. al [26] and M. Dadvar et. al. [1]. One thing is very important that our method is still used to classify subjective sentences into negative class or to handle negation of subjective sentences.

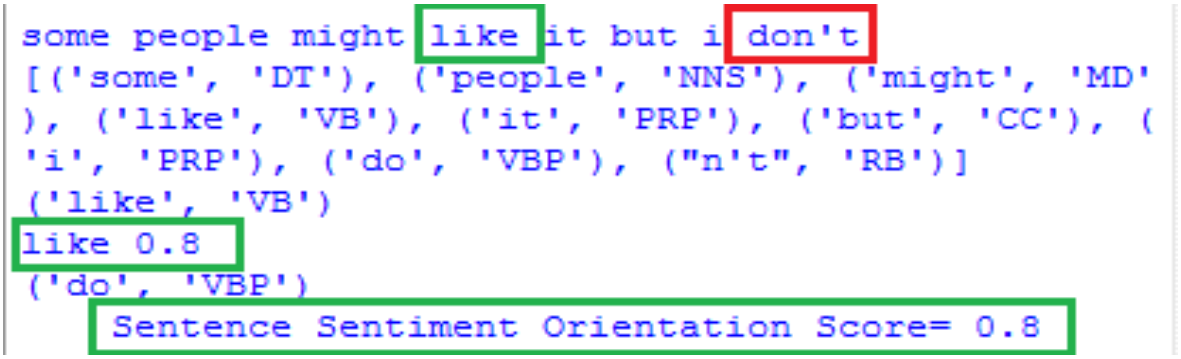

Figure 9:- Negation word at last position in sentence

Our negation handling method is still successful to identify and calculate sentiment score of subjective sentence but only failed to identify the negation word at last position in any subjective sentence as shown in above fig. 9.

VIII. CONCLUSION & FUTURE SCOPE

This paper focuses on product and social issues sentiment analysis approaches different techniques to sentiment analysis and identification of negative sentences and calculates sentiment score using different negation handling rules. While still, there are a number of challenges to indentify and calculate the sentiment score of negative sentences. First, identify the Verb "ing" form; we still not identify those verbs. Second, we identify the negation words in sentence at any position except at last position of the sentence (just before the end of sentence).Negation word/term at the end of a sentence is likely to affect preceding rather than following words. But our method not identifies the "negation words" at last position in sentence. Future work will include identification of verb-ing form, negation word at end position in sentence and classification of sentence into positive or negative class.

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