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Sarcasm Detection in Hindi sentences using Support Vector machine

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Abstract: ***Natural Language Processing has many applications, and Sentiment Analysis is one of them. In Sentiment Analysis, Sarcasm is the major factor which can flip or reverse the polarity of the message to be conveyed. Use of positive words to convey a negative message makes it harder to detect. Today, on social media regional languages are widely supported and sarcasm has gained popularity among the users to convey their sentiment regarding any topic, issue or person . In this paper we have collected and also generated sarcastic sentences in Hindi language. Hindi is a language spoken by about 370 million people worldwide [28]. In our suggested approach we have tried to detect sarcasm on two categories of sarcastic statements ,namely with markers and without markers .For the class of sarcastic statements having special markers like #tag, emoticons, punctuation marks etc. to indicate the sarcasm ,it was suggested to use lexical, pragmatic and linguistic features. Using these corpora we have trained libsvm® - multi-class classifier for total 5 classes named Non-Sarcastic, Mild Positive Sarcastic, Extreme Positive Sarcastic, Mild Negative Sarcastic and Extreme Negative Sarcastic .The method given was tested on nearly 1400 sentences and it was found to give 84%accuracy. For the group of sarcastic statements which had no special clues or markers to indicate presence of sarcasm, the detection of the sarcasm was done with 60% accuracy. And these results were observed by applying the suggested methodology using support vector machine, on nearly 250 sentences.***

Keywords: Sentiment Analysis; Opinion Mining; Sarcasm Detection; Natural Language Processing; Text Processing; Machine Learning; Support vector machine.

I. INTRODUCTION

Today, many social media sites have allowed users to express their emotion in their regional language with their label to their messages [1]. According to survey carried out on 2000 American adults for their online purchase habit ,it was found that 73 -83 percentage of online users were influenced by such online reviews [29]. "Sarcasm is a form of ironic speech commonly used to convey implicit criticism with a particular victim as its target" (McDonald, 1999, 486-87). Sarcasm detection is one of the challenges in Sentiment Analysis (SA).

Sentiment Analysis (SA) can be performed at three levels: document-level, sentence-level, and aspect-level. However, sentences can be considered as a short document, which removes fundamental difference between document-level and sentence-level SA.

In our paper, we have focused on detection of sarcastic sentences presented in the textual form expressed using Hindi language. One major issue in sarcasm detection is the data set availability.

In this research following work is carried out and explained in following sections:

- Generation of sarcastic sentences in Hindi language.

- Novel technique suggested and tested, which can work even in absence of any clear sarcastic marker features.
- Analysis of the results obtained and suggestions for later enhancements possible thereof.

This paper might be very helpful to Naïve researchers in this field.

II. Challenges in Sarcasm Detection

Sarcastic sentences express the negative opinion about a target using positive words.

"मुजे अपमानित होना पसन्द है" [i like being insulted]

Identification of sarcastic sentences is a difficult task. In most of the cases we collect sentences from social media platform where nature of sentence is not fixed i.e. not all grammar rules are followed. Second short sentence size makes it difficult to get context of sentence. Few other issues to be tackled are as follows:

- In some case of sarcasm detection world knowledge is required .Ex :"*वाह इंटरनेट यहाँ काफ़ि तेज है!!" [vow internet is amazingly fast here!!]* .This statement might be non-sarcastic if the internet in question is indeed fast else otherwise.
- In spoken statement sarcasm can be identified with particular notation or facial expression but for written text no such clues can be found which make it is difficult to detect[1].

Besides above there are also few very specific issues to be handled in Hindi langauge like:

- Hindi is a free order language i.e the subject, object and verb can come in any order . whereas English like languages are fixed order i.e. subject followed by verb and followed by object. Some examples are mentioned in TableI below.

TABLE I: WORD ORDER SIGNIFICANCE IN ENGLISH AND HINDI LANGAUGES

English Sentence	Order of Words
Ram ate three apples	Correct/Valid order SVO
Ate ram three apples	Incorrect/Invalid order VSO
Three apples ate ram	Incorrect/Invalid order OVS
Hindi Sentence	**Order of Words**
राम ने तीन आम खाए	Correct order SOV
तीन आम खाए राम ने	Correct order OVS
खाए तीन आम राम ने	Correct order VOS

In Hindi language, same word with same meaning can occur with different spellings, so it's quite complex to have all the occurrences of such words in a lexicon and even while training a model it's quite complex to handle all the spelling variants .Some examples are shown in TableII below. In tableII , the three columns indicate same words but having different spellings.

Table II: SPELLING VARIATIONS IN HINDI LANGAUGE

संबंध	सम्बंध	सम्बन्ध
महंगा	मंहगा	महँगा
ठंढा	ठंडा	ठण्डा

- For Hindi Language, there is lack of sufficient resources, tools and annotated corpora.

III. Review Work

Sarcasm is well studied by psychologists, behavioral scientists and linguists [20]. But for text mining automatic detection of sarcastic sentences is difficult task [16] and it has been addressed by few researchers. Pang and Lee, in 2008 had provided comprehensive study in field of opinion mining. Tepperman et al. (2006) had identified the sarcasm based on 'yeah-right' pronunciation in spoken form. Kreuz and Caucci (2007) studied the influence of different lexical factors like interjections and punctuation symbols in recognizing sarcasm in written form. Filatova (2012) presented a detailed description of sarcasm corpus creation with sarcasm annotations of Amazon product reviews[1].

Tsur et al. (2010) have proposed a semi - supervised framework for automatic detection of sarcastic and non-sarcastic sentences in Amazon reviews and Twitter messages. Their framework exploits syntactic and pattern based feature in sarcastic sentence of Amazon product review. Devidov et al. (2010) have used sarcastic Twitter message and Amazon product review to train the classifier using syntactic and pattern based feature [18]. They have studied the reliability of sarcasm hash-tag as the golden standard for evolution but found that hash-tags are noisy in nature. Work done by [16], [17], [18], [19],[20] and [21] have used traditional supervised classification techniques like Support Vector Machine (SVM), Conditional Random Field (CRF), and Naïve Bayes along with some Lexical-based techniques .Anand et al [32] have offered more detailed survey of techniques for sarcasm detection .

It was shown by Thorsten Joachims et al [31] that SVMs consistently achieve good performance on categorization tasks, outperforming existing methods substantially and significantly. With their ability to generalize well in high dimensional feature spaces, SVMs eliminate the need for feature selection making the application of text categorization considerably easier. Another advantage of SVMs over the conventional methods is their robustness. SVMs show good performance in all experiments avoiding catastrophic failure like observed for the conventional methods on some tasks. Furthermore, SVMs do not require any parameter tuning, since they can find good parameter settings automatically.

IV. Data Collection and Generation

Initially it was targeted to collect Hindi sentences from online sources which contained tag "#Kataksh"*(word for sarcasm in Hindi)* or markers like emoticons - 😏 , 😊 , etc or punctuation like- "!", "?!" etc . As not sufficient statements were gathered in this effort, next we used polarity labelled corpora of Hindi sentences generated by Aditya Joshi et al.[4]. Then with help of language experts from this polarity labelled corpora, by adding appropriate markers, sarcastic sentences were generated. Total of 1410 sentences such sentences were available in this group of corpora. For these statements with markers, only reviews from movie domain were used; hence the context was fixed in those statements.

Besides these, sarcastic sentences in language other than Hindi were also collected.The speciality of these statements was absence of markers as the meaning was conveyed by words solely. Again these statements were converted to equivalent Hindi versions with help of language experts and subsequently we had 250 direct opinion statements having no explicit sarcasm markers.

Also following special lists of Hindi langauge were also prepared in this work:

1. Word-Antonym Pair (more than 1000 words) - where a word and its Antonym are stored .

Ex:- अल्प – अधिक [scanty – excessive], कोमल-कठोर [delicate- cruel] , उदय-अस्त [rise –fall], चढ़ना-उतरना [ascend-alight]

2. Positive and Negative word lists (more than 800 words),where we store those words to which we can generally associate a positive sentiment or negative sentiment respectively.

Ex: Positive words list: "एकता"*(Unity)* , विश्वास"*(Trust)*,"स्वर्ग" *(Heaven)*

Ex: Negative words list:"अंधकार"*(Darkness)*, "आलसी" *(lazy)*

3. Cue words list:- Special words that occur at beginning in sarcastic sentences E.g. "हा, हा, हा", *(ha , ha ,ha)* "अरे!" *(Oh)*, "वाह!" *(vow)*, "अच्छा!" *(great)*. "ओह!" *(oh)*.

Also the emoticon symbols are grouped according to their intensities into mild positive , mild negative , extreme positive and extreme negative emoticon groups. For ex : if it is normal smiling emoticon, we consider it as mild positive, whereas if a emoticon is showing tears due to uncontrollable laughter , it is considered as extreme positive emoticon.

V. PROPOSED ALGORITHM

Step 1: Get Direct Opinion Sentences.

//Data Pre-processing

Step2: Remove UserName, Hyperlink, tabs etc from the Sentences.

Step3: Replace multiple occurrences of same or opposite type of emoticons with a single appropriate emoticon.

Step4: If sentence contains marker - #tag kataksh or emoticons , go to step 5 else go to step 10.

// Feature Extraction for statements containing sarcasm markers

Step 5: Find TFIDF using following method:

Given a document collection "D", a word "w", and an individual document d ϵ D, we calculate

$$w_d = f_{w,d} * \log(|D|/f_{w,D})$$

Figure 1

where $f_{w,d}$ equals the number of times "w" appears in "d", |D| is the size of the corpus, and $f_{w,D}$ equals the number of documents in which "w" appears in "D". [30]

Step 6:- Lookup the positive (+ve) score and negative(-ve) score of each word in sentence from *HindiSentiWordNet*.

Sum the scores of all words to give score of sentence.

Set the polarity of entire sentence = +ve, if the total +ve score of all the words is greater, -ve otherwise.

Step 7: If Sentence contains #Kataksh, set " #Kataksh = true " .

Step 8: If emoticon present, find the intensity(I) of the emoticon and set "Emoticon=I".

Example :- if emoticon is  ,  ,  then intensity= "mild positive" , " positive" , "extremely positive" respectively.

Step 9: Classify sentences as per rules given in table III and return appropriate class.

TABLE III CLASSES OF SARCASTIC SENTENCES

Features			**Class Label**
Statement Polarity	**Emoticons**	**#Kataksh**	
Positive	Not used	True	Extreme +ve Sarcastic
Negative	Not used	True	Extreme -ve Sarcastic
Negative	Mild Positive	False	Mild +ve Sarcastic
Positive	Mild Negative	False	Mild -ve Sarcastic
Negative	Extreme Positive	False	Extreme +ve Sarcastic
Positive	Extreme Negative	False	Extreme Negative

			Sarcastic
Positive	Positive	False	Non-Sarcastic
Negative	Negative	False	Non-Sarcastic

//Step for statements having no sarcasm markers.

Step 10: if sentence has at least one of the following feature cue words OR odd combination of words OR pair of word and its antonym. Return "sarcastic" else "non-sarcastic".

VI. EXPERIMENTAL RESULTS AND SETUP

The experiments were performed in three setups as explained below. 10 fold cross validation is applied in each setup. Accuracy is the parameter for evaluation for all the experiments as well for comparison of results. The figure 2 below indicates the formula used to compute the accuracy.

$$\text{accuracy} = \frac{\text{number of true positives} + \text{number of true negatives}}{\text{number of true positives} + \text{false positives} + \text{false negatives} + \text{true negatives}}$$

Fig. 2

1) **Experiment setup I:** Initially we tried to find influence of tag #kataksh for detection of Sarcastic sentences .

Total sentences: - 404 sentences

Classifier settings: - Support Vector Machine Kernel: - linear

Target classes: - two (sarcastic, non-sarcastic)

TABLE IV RESULT OF EXPERIMENTAL SETUP I

Sr.No	Features	Accuracy%
1	Unigram(TFIDF), #tag Absent	67.05%
2	Unigram(TFIDF), #tag Present	78.84%

Results have shown the fact that #tag has great influence in detecting the sarcastic sentences.

2) Experiment setup II: *For second experiment we have gone with multi class classification on statements with markers.*

Total sentences in corpus: 1410 sentences

Model settings: - LibSVM

Kernel:- C-SVM, Type: RBF, C=0.5, gamma = 0.009

Target clasess:- five (extreme positive /extreme negative/mild positive /mild negative sarcastic/ non sarcastic).

TABLE V RESULTS OF EXPERIMENTAL SETUP II

Sr.No	Features	Accuracy %
1	Unigram(TFIDF)	50.03%
2	Unigram(TFIDF) + Pos. Score + Neg. Score	50.40%
3	Unigram(TFIDF) + Pos. Score + Neg. Score + #tag	59.55%
4	Unigram(TFIDF) + Pos. Score + Neg. Score + #tag + Emoticons	66.65%

5	Unigram(TFIDF) + Pos. Score + Neg. Score + #tag + Emoticons + Polarity	83.74%

3) Experiment setup III: Data set with no external markers like #Tag, Emoticons or "!" marks. For such statements, we have used three special features explained in table VI –

TABLE VI FEATIRES USED IN EXPERIMENTAL SETUP III

Feature	Example	Sarcastic sentence with the feature
Presence of word and its Antonym	प्यार- नफरत (love – hate)	मैं शाकाहारी नहीं हूँ क्योंकि मैं जानवरों से प्यार नहीं करता , मैं शाकाहारी हूँ क्योंकि मैं पौधों से नफरत करता हु (I am not vegetarian as I love animals, I am vegetarian as I hate plants)
Presence of odd combination i.e positive sentiment with negative words OR negative sentiment with positive word	(खराब- शानदार) (bad- excellent)	खराब अभिनय मे उनका शानदार प्रदर्शन (his excellent performance in bad acting)
Presence of cue words at start of statement	हा, हा, हा ! (ha ha ha !)	हा, हा, हा ! अब तुम बताओगे हम क्या बोले ! (ha ha ha ! now you would say what we speak!)

Total sentences without markers: 250

Model settings :- LibSVM

Kernel:- C-SVM, Type: RBF, C=0.5, gamma = 0.009

Target classes:- two (sarcastic , non-sarcastic)

Accuracy achieved:- **60%**

Analysis of Results: After performing various experiment we achieved average accuracy of around 83% when markers were present. Major reason for failure of suggested model was that polarity of document not correctly assigned which in turn was due to our dependency on HindiSentiWordNet which has some words still missing. Also it is observed that when we don't have any markers, the accuracy drops to nearly 60%. It was found that such statements would need World Knowledge type of features to identify it as sarcastic.

e.g. **भारत बीते हुए कल के हार्डवेयर पर आने वाले कल के सॉफ्टवेयर चल रहा है**

(India is running futuristic software on outdated hardware)

For given example we must have knowledge regarding "हार्डवेयर" (hardware) and "सॉफ्टवेयर" (software) both and also about Technological development of India in current times, to correctly detect presence of sarcasm.

VII. CONCLUSION

After going through prominent research articles in this area for exploring various techniques and then performing various experiments based on features suggested by us, we have achieved accuracy of nearly 83%, in those cases where statement has good sarcasm indicators. Generally external Marker makes it easy but without marker it would become more difficult to detect sarcasm.

We also conclude that identifying sarcastic sentences would need more knowledge regarding topic, issue or individual which leaves us for future enhancement of sarcasm detection techniques by incorporating world knowledge, Named Entity

Recognition, Semantic Information etc. Also it would be interesting to check the performance of suggested technique on other domain, in other languages and other supervised learning techniques.

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