

Computing Sentiment Polarity of Opinion WHY Type Question for Intention Mining of Questioners in Question Answering Systems

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Abstract. Opinion question answering systems (OQAS) search for answers from public opinions available on social web. WHY questions asked in OQAS expect answers to incorporate reasons and explanations for the questioners' sentiments expressed in the questions. Sentiment analysis has been recently used for determining sentiment polarity of WHY-questions so as to find the intention of users with which he is looking for getting information related to products. In our recent research [14, 15], we address complex comparative WHY types questions and propose an approach to perform sentiment analysis of the questioners. For example, the question, "I need mobile with good camera and nice sound quality. WHY should I go for buying Nokia over Samsung?" we determine the main focused product (Nokia) with respect to questioner's perspectives who shows positive intention for buying mobile. The work does not deal with questions that have mixed emotions like WHY Dells are ok, HPs aren't that good, but Macs are Fantastic. Moreover, the work does not perform feature specific (camera and sound quality) sentiment analysis of questioners. In this paper, we perform the feature based sentiment analysis of questioners. We also address complex questions that have mixed emotions towards different products. We examine semantic structures of questions and propose an approach for sentiment analysis of questioners on product review sites. We finally conduct experiments which obtain better results as compared to existing baseline systems.

Keywords: Question Answering; Information retrieval; natural language processing; natural language understanding and reasoning.

1 Introduction

Opinion Question Answering System (OQAS) retrieves answers from user generated data on web. Research on the complex questions such as 'WHY' has been very constrained [14, 15, 18, 19].

Sentiment analysis has been recently used for determining sentiment polarity of WHY-questions so as to find the intention of users with which he is looking for getting information related to products [1, 2, 4, 5, 6]. Research related to WHY-opinion ques-

tions consider simple WHY-questions expressed in single sentence [1, 3, 4, 25, 26]. TAC 2008 competition incorporated only simple WHY type questions like, "WHY did people like Megan" [25, 26].

In our recent work [15], we propose a method for identifying the key opinionated span within WHY questions asked on product review sites. We make use of a discourse parser [9] to fragment questions into different text segments for effective opinion mining. Subsequently, the polarity score of the most important text segment is computed using knowledge based approach with the help of semantic role labeler [13].

For example, I need mobile with good sound quality and nice looks. WHY should one feel happy after buying x? Our method traces 'x' as main focused product with the intention (positive) of questioner with respect to 'x'. There are limitations in the work. The work does not perform feature specific (sound quality, and looks) sentiment analysis. It is common that a questioner may have positive intentions for some features and negative intentions for other features of a product.

Secondly, the approach could not find main focused product in questions like, "If I need a great mobile that could handle basic computing needs. WHY should I go for Samsung over Nokia?", "WHY Dells are ok, HPs aren't that good, but Macs are Fantastic", "WHY there are more favorable comments about Nokia than Micromax", "WHY people are incredibly more dissatisfied with battery backup of Nokia in comparison to Samsung" etc.

In this paper, we propose a method to perform feature based sentiment analysis of questioners from the questions. We also determine the main focused product with respect to questioner's perspectives. In this regard, we perform semantic analysis of WHY Questions through a parser Enju[20]. We split the question into different group based on features of a product. Further, we identify feature related expressions in WHY type questions and compute the sentiment polarity of WHY type questions based on different features described in questions.

In summary our contribution is as follows:

1. We make use of existing opinion lexicons for determining sentiment polarity of WHY Questions asked on product review sites and evaluate their efficiency.
2. We address feature based sentiment analysis of questions.
3. We address opinion mining from complex comparative sentence. We propose a method that extracts main focused product of the author from comparative questions.

Rest of the paper is organized as follows. Section 2 deals with a review about 'WHY' QAS. Section 3 discuss about proposed approach for determining sentiment polarity of WHY Questions. We conclude and identify future scope in Section 4.

2 Related Work

Based on works on opinion question answering [1, 2, 4, 5, 6, 10, 14,15], we find that sentiment polarity analysis of an opinion question is the key component in drawing answers to opinion 'WHY' questions. Sentiment polarity of opinion questions is de-

terminated through identification of opinionated words and computation of their polarity score through opinion lexical resources [1, 2, 4, 5, 6, 14, 15].

S. Moghaddam et al consider only adjectives as opinionated words for the task of determining sentiment polarity of questions [4,8]. Jong huet al. consult a Japanese polarity dictionary in their question answering [2].The dictionary is not available in English. Jianxing Yu et al. [5] develop an OPQA and determine sentiment polarity of questions with the use of MPQA sentiment lexicon [7]. Most of the words in MPQA project are objective words such as buy; purchase, choose etc. Hence, we consider the corpus as not a good choice.

OpinionFinder [7] performs document level analysis and identify subjective sentences and sentiment expressions in the text. The document level analysis is not appropriate for questions that have multiple opinions on different features of products.

The existing average scoring methods approach [1, 2, 4, 5, 6, 14, 15] could yield false results in determining sentiment polarity of questions e.g. WHY Nokia is good but Micromax is a bad mobile?

Ganapathibhotla et al. [11] perform Opinion Mining in Comparative Sentences with an assumption that objects generally appear on both sides of a comparative word. This is not true in some cases like WHY it is better to have Nokia over Samsung?;"WHY there are more favorable comments about Nokia than Micromax"

In our previous work [15], we use semantic role labeler to identify main focused product from comparative sentences in WHY question answering. The method do not give promising results on some complex questions like "If I need a great mobile that could handle basic computing needs. WHY should I go for Samsung over Nokia?", "WHY Dells are ok, HPs aren't that good, but Macs are Fantastic", "WHY there are more favorable comments about Nokia than Micromax", "WHY people are incredibly more dissatisfied with battery backup of Nokia in comparison to Samsung" etc.

Stanford Sentiment [12] has not shown good performance on opinion WHY questions asked on product review sites [19].

From the literature surveyed in this section, we find that sentiment analysis of questioners from complex comparative WHY questions are still an issue.

3 Proposed Approach

In this section, we determine sentiment polarity of questioners. The recent work [1, 14, 15, 16] which does average scoring of words could yield false results in determining sentiment polarity of questions e.g. WHY Nokia is good, Samsung is okay but Micromax is a bad mobile.

Our aim is to find sentiment of a questioner based on interpretation of the WHY question asked by him or her.

There is a need to split a WHY- question into different text segments based on different features of products. We further compute sentiment polarity of the question.

3.1 Splitting of WHY-Questions into Different Segments

The objective is to identify the key opinionated spans based on individual feature or product within a WHY question. For example, in question, WHY Dells are ok, HPs are good, but Macs are Bad. The text segments are: (Dells are ok); (HPs are that good); (Macs are bad).

In this regard, we parse the sentence of question through a parser [18]. We examine the output of the parser and create a rule for finding the key opinionated spans. Rule is as follows:

Extract semantic arguments connected with each verb (v1, v2 and so on).

1. The arguments will be in the form of (arg1, verb_arg12, arg2) and name such groups as Group 1, 2 and so on.
2. If there is a word adj_arg1 that is semantically related to arg1, we annotate the element (adj_arg1(arg1)). Same is done for verb_arg12, and arg2.
3. If the arg1 or arg2 is a phrase and there is verb in the phrase, we repeat the process of tagging from step 1.

Based on the analysis, we form each group as [{adj_arg1 (arg1) - adj_verb (verb) - adj_arg2 (arg2)}. {adj_arg1 (arg1) - adj_verb (verb) - adj_arg2 (arg2)}. {adj_arg1 (arg1) - adj_verb (verb) - adj_arg2 (arg2)}].

Separate groups (Group 1, 2 and so on) are created for all other verbs present in the question.

3.2 Computation of sentiment polarity of each group

We compute sentiment polarity of each group through following steps as discussed below:

- **Computing score of Opinion word:** we compute the score of each opinion word of each group.
- **Computing score of Group:** we finally use the scores of all words in the group to perform sentiment analysis of questioners.
- **Computing score of Opinion word:** We follow proposed approach used in [15] to compute sentiment polarity of each word. We make combined use of MPQA subjectivity Lexicon and SentiWordNet. Details are given in [15].
- **Sentiment analysis based on Features:** We manually compile list of products and their features collected from different review websites.

So the products and their features are already known. We compute the sentiment polarity of each group.

- Case 1: If in a group g1, there is only one feature then, the sentiment polarity of the group provide opinion on the feature (as positive and negative).
- Case 2: If there are more than one features f1 and f2 in a group. Firstly, we search for adj_arg1 and arg1 relationship where any feature could be arg1. Final score is computed in following manner:

- (a) If both *adj_arg1* and *arg1* are positive, then the combination is made positive with score that is largest in magnitude of the two arguments.
- (b) Else if both *adj_arg1* and *arg1* are negative, then the combination is made positive with score that is largest in magnitude of the two arguments.
- (c) Else, the combination is made negative with score that is largest in magnitude of the two arguments.

In this way, we have two separate scores for *f1* and *f2* as *SF1* and *SF2*.

Secondly, we compute score of the group based on *F1* and *F2*.

We compute the scores (*S*) of other members i.e., members except (*adj_arg1 f1*, *adj_arg1 f2*).

Feature1 = aggregate score of (*S*,*SF1*)

Feature2 = aggregate score of (*S*,*SF2*)

In a question: WHY Nokia is a great product for a good price when compared with Samsung?, we see that there are more than one feature (product, price) found in the group. We find semantic relation as:

- Nokia is (a [(great) product] for a [(good) price])
- score of product = score (Nokia + is +a+ great)
- score of price = score (Nokia +is+a+ for+good)

Some examples are given below in Table 1.

Table 1. Identification of feature related expression of product from questions

Examples	Group1	Group2	Group3
WHY Dells are ok,	Dells <u>are</u> ok	HPs <u>are</u> (that good)	Macs <u>are</u> Fantastic
HPs aren't that good,	-Arg1 arg_12 arg2	<u>Arg1 arg_12 arg2</u>	-Arg1 arg_12 arg2
but Macs are		Not <u>are</u>	
Fantastic		Adj_arg1 arg1	

As per our algorithm,

- In question 1: We have group 1 as Dells are ok ; group 2 as HPs (not are) (that good); group 3 as Macs are Fantastic.
- In question 2: We have group 1 as (The price and features) is (the [(main) concern]); group 2 as I neglect Nokia.
- In question 3: We have group 1 as I need (a mobile with [(ergonomic) design]); group 2 as I recommend Nokia
- In question 4: We have group 1 as Nokia is (a [(great) product] for a [(good) price])

3.2 Computing Sentiment Polarity of WHY Type Questions Using Existing Systems

We determine the polarity of forty Questions through the existing systems [Question Data Set is given after reference section under heading “Question Set for computing sentiment polarity”]. We compare six systems in Table 2.

Table 2. Performance of popular existing systems for sentiment analysis of questioners (on 40 questions given in Appendix 1).

System	MPQA [7]	SentiWordNet [21]	Wordnet [21]	Bing Liu [21]	SenticNet [16]	SentiStrength [18]
Accuracy	65.5%	65.5%	40%	60%	65.5%	67.5%

We perform comparative analysis of different lexicons used in our proposed method in Table 3.

Table 3. Performance of our method using different lexicons (on 40 questions given in Appendix 1)

Dictionary used in our method	SentiWordNet [21]	MPQA Lexicon [7]	Bing Liu Opinion Lexicon [21]	SenticNet 3.0 [18]
Accuracy	75%	57%	47%	67%

3.3 Addressing comparative opinions

We analyze 39 different forms of comparative questions (see Appendix 2). Following rules are followed to extract main focused product.

1. If in a group, there is only one product then, the only product is main focused product.
2. If in a group there are more than one products described in a group, then we follow rules as follows:
 - If there is a semantic relation: arg1 prep_arg12 arg2. Moreover, a product p1 is present in arg1 then, we select the product p1 as main focused product.
 - Else if there a semantic relation: arg1 prep_arg12 arg2 where a product p2 is arg2 and a word w1 is arg1. The word w1 has semantic relation: adj_arg12 with arg1 (product p1). Product p1 is selected as main product.

The performance of our method and existing methods on Question Set is presented in Table 4.

Table 4. Performance of existing systems in finding main focus

Method for finding main focus	Bing Liu	Mishra et al [15]	Ours
Accuracy	58.97%	71.7%	94.87%

4 Conclusions and Future Works

In this paper, we determine the sentiment analysis of the questioners from multi featured complex questions through proposed algorithm. We perform semantic analysis of WHY type questions and identify opinionated spans before computing sentiment polarity of question. The segmentation of WHY-questions is reliant on performance of automatic Enjuparser. Instead of computing score of each word of the group, we examine that find relevant opinion words and using their scores could enhance the accuracy of 'WHY' QAS. We comprehend that SenticNet, SentiWordNet, MPQA are general opinion lexicons. There is a need for domain specific lexicons for effective opinion mining.

Our future work will be to employ ranking strategies for ranking features desired from question by questioners. We will exploit machine learning methods for the sentiment analysis of questioners. We will work on sentiment analysis of questioners posing questions in Arabic language.

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Appendix 1. Question Set for Computing Sentiment Polarity

3. WHY should I buy Nokia if I need mobile with good looks and nice sound quality?
4. WHY should I look for Nokia if I need mobile with good looks and nice sound quality?
5. WHY should one feel sad after buying X?
6. I need mobile with good sound quality and nice looks. WHY should one feel sad after buying x?
7. If I need mobile with good looks and nice sound quality, WHY should I insist Nokia?
8. WHY Nokia should be good option when we need a mobile?
9. WHY Nokia is good pick as a mobile?
10. WHY should one regret for long time after buying Nokia?
11. I went to market because I need mobile with good camera. WHY Should I go for Nokia?
12. WHY I bought Nokia at cheaper price but feel cheated?
13. WHY should one suggest Nokia as an alternative to x?
14. I went to market and bought Nokia. WHY should I feel satisfied finally?
15. WHY I went to market for buying Nokia?
16. I went to shop. I heard good things about Nokia. Hence I bought it. WHY Should I be happy?

17. If I need Nokia then WHY Nokia lumia is first choice?
18. WHY one feel cheated in the end after spending money on Nokia?
19. WHY one gets sick but need Nokia for daily purpose?
20. WHY should one is inclined towards Nokia next after getting salary?
21. I went to shop. I took money from atm. I want good mobile. WHY should I order Nokia?
22. WHY should one buy Nokia instead of looking for its bad reviews?
23. If the price is another driving influence for purchasing mobile for me, I should choose Nokia over Samsung?
24. WHY Nokia is a great product when compared with Samsung
25. I would like at least a 4 hr. battery life. WHY should I advise Nokia over Samsung.
26. If I need a great mobile that could handle basic Computing needs. WHY should I go for Samsung over Nokia
27. WHY users cite negative reasons for those who prefer Nokia over Samsung
28. WHY people expressed positive opinions for Nokia as a better mobile when compared with Micromax
29. WHY one consider leaving x as alternative to y when there is requirement for good battery back up
30. WHY do Users cite negative feedback on mobiles manufactured by Nokia?
31. WHY people have objections against NAFTA
32. WHY should one aspire for Nokia instead of looking for its bad reviews?
33. WHY Nokia is wonderful, but very dangerous when it comes to emitting heat.
34. WHY people disapprove Nokia as best mobile in market.
35. WHY criticisms have been made about System of a Down or its music?
36. WHY people have the issues with Nokia Lumia
37. WHY Nokia is less competent in market when compared with Samsung
38. WHY people have objections toward Mayo or its products or research?
39. WHY Nokia is being considered worst than Samsung?
40. WHY people like Nokia better than Samsung?
41. WHY Nokia is good but Samsung is better mobile?
42. WHY it is better to neglect Nokia over Micromax?

Appendix 2. Questions Set for Finding Main Focus

43. WHY Dells are ok, HPs aren't that good, but Macs are Fantastic
44. The price and features is the main concern. WHY should I neglect Nokia over Samsung
45. I need a mobile with ergonomic design. WHY should I recommend Nokia over Samsung
46. My previous purchases were with Dell and HP. WHY should I prefer Nokia over dell and HP?
47. The price is another driving influence for purchasing mobile for me. I should propose Nokia over Samsung?
48. WHY Nokia is a great product for a great price when compared with Samsung

49. WHY people are incredibly more dissatisfied with battery backup of Nokia in comparison to Samsung
50. I would like at least a 4 hr. battery life. WHY should I advise Nokia over Samsung.
51. If I need a great mobile that could handle basic computing needs. WHY should I go for Samsung over Nokia
52. WHY users cite negative reasons for those who prefer Nokia over Samsung
53. WHY people expressed positive opinions for Nokia as a better mobile when compared with Micromax
54. WHY there are more favorable comments about Nokia than Micromax
55. WHY Nokia is being considered worst than Samsung?
56. WHY people like Nokia better than Samsung?
57. WHY Nokia is good but Samsung is better mobile
58. WHY fan following of bajrangi bhaijaan is cut by release of bahu bali
59. WHY one consider buying x as alternative to y when there is requirement for good battery back up
60. WHY should I love pictures taken by Nokia in place of Samsung
61. WHY should I give preference to Nokia over Micromax if I am looking for bad mobiles
62. WHY there are more favorable comments about Nokia than Micromax
63. WHY people say that it is better to have Micromax over Nokia in England than USA?
64. WHY people say that Nokia is better than Micromax in England than USA?
65. WHY people say that it is better to neglect Nokia over Micromax in England than USA?
66. WHY people say that Nokia is not as good as Micromax in England than USA?
67. WHY people say that Nokia is more valuable than Micromax in England than USA?
68. WHY people say that Micromax is good but Nokia is better in England than USA?
69. WHY people say that in market Nokia is more popular than Samsung in England than USA?
70. WHY people say that Nokia is much better than Samsung in England than USA?
71. WHY people say that Nokia is more efficient than Samsung to buy in England than USA?
72. WHY people say that people prefer Nokia over Micromax in England than USA?
73. WHY it is better to have Micromax over Nokia?
74. WHY Nokia is better than Micromax?
75. WHY it is better to neglect Nokia over Micromax?
76. WHY Nokia is not as good as Micromax?
77. WHY Nokia is more valuable than Micromax?
78. WHY Micromax is good but Nokia is better?
79. WHY in market Nokia is more popular than Samsung?
80. WHY Nokia is more efficient to buy than Samsung?
81. WHY people prefer Nokia over Micromax?