Query Keyword Extraction from Complaint Data for Collecting Advice

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***Abstract*—Nowadays, there are a large number of users who post complaints about a certain service on the Internet. Because users have various values and views, even if they receive the same service, they may complain in different ways. However, it is quite difficult to respond to various user demands for service in real time and there are almost no direct solutions when users feel dissatisfied with a certain service. Therefore, in this paper, we propose a method that generates query keywords according to various user complaints about a certain service for collecting advice. To generate query keywords, we extract the company names, complaint topic words and advice topic words from complaint data. Then suitable web pages containing advice are recommended from the results of the query. This advice could address users' dissatisfaction and respond to their different demands in a comprehensive way.**

***Index Terms*—query extraction, complaints, advice.**

I. Introduction

NOWADAYS, there are a large number of users who post complaints about a certain service on the Internet. Because users have various values and views, even if they receive the same service, they may complain in different ways. However, it is quite difficult to respond to various user demands for service in real time and there are almost no direct solutions when users feel dissatisfied with a certain service. What's more, it is difficult to determine the expected solutions if the query keywords are not appropriate, especially for certain users who are not used to online search, like the elderly and foreigners. For instance, users might complain about an online retailer's cardboard box using different phrases such as "the size is too big," "low quality," or "over-wrapped." It is difficult to resolve users' complaints in a direct way because items such as a cardboard box are chosen by retailers and users cannot determine their size or quality by themselves. Moreover, the expected solutions would not be found if users search with keywords such as "cardboard box, too big." Hence, we suggest resolving users' complaints in an indirect way by offering them advice like "how to modify a cardboard box" or "how to utilize a cardboard box for storage."

To offer these kind of advice, in this paper, we propose a method that generates query keywords according to various user complaints about a certain service. To generate query keywords, we first analyze complaint data from the Fuman Kaitori Center website and extract company names from the data. Second, from the negative reviews for each company, we extract complaint topic words that represent users' dissatisfactions. Third, we extract advice topic words that can help users to collect advice according to their complaint. Finally, we generate the query based on the company name, complaint topic word, and advice topic word. Moreover, we use an OR-based search to acquire suitable web pages containing advice by using the result of the query. This advice could address users' dissatisfaction and respond to their different demands in a comprehensive way.

The remainder of this paper is structured as follows. Section II presents a brief summary of related work. Section III introduces the dataset we use for research and explains the proposed method. Section IV discusses the experimental results and the evaluation of the proposed method. Finally, Section VI concludes this paper and discusses future work.

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II. Related Work

A. FKC dataset

The FKC dataset has been used for several studies in recent years. Mitsuzawa et al. [1] presented the FKC dataset which is from Fuman Kaitori Center (FKC). Fuman means dissatisfaction in Japanese. The FKC is a Japanese consumers' negative opinion data collection and analysis service. In our work, we used and analyzed the FKC dataset.

Hasegawa et al. [2] analyzed and visualized the contents of the FKC dataset such as the distribution of users' ages, jobs, and gender. In our work, we determine the aims of the experiment based on their results.

Hayashi et al. [3] proposed a system to recommend appropriate products for users according to their complaints. This recommendation could directly resolve users' dissatisfaction with certain products. In our work, we propose a method to resolve user complaints about services instead of products in an indirect way.

B. Topic Word Extraction

Sakai et al. [5] proposed a method to extract negative words as the expressions of dissatisfaction from blogs. They extracted nouns, adjectives to make a dissatisfaction expression dictionary. In our work, we only extract nouns because nouns can explain and represent the content of users' complaints.

Hashimoto et al. [6] proposed a method to extract important topics from newspaper and detect social problems based on document clustering. Ustumi et al. [4] proposed a method to extract technological solutions to social problems such as medical issues from the news. They extracted technological solution words by calculating the relevance of problems and technologies. They defined the relevance calculation as problem relevancy and technical relevancy. A higher value of relevancy indicated a higher possibility of being able to

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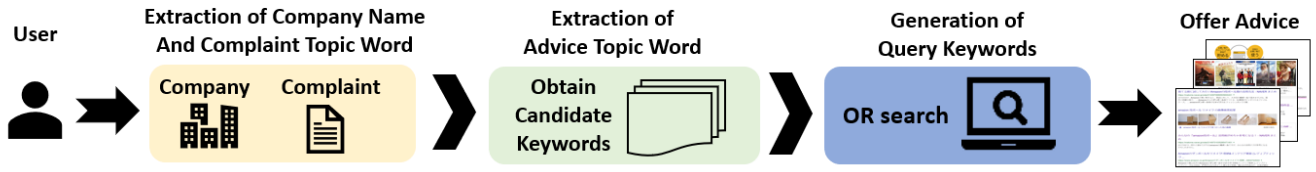

Fig. 1. System Flow

extract a technological solution word. In our work, we use this concept and extract the advice topic word by calculating the relevance of the company and complaint topic. However, we hypothesize that a lower relevancy indicates a higher probability that a word is an advice topic word.

Yoshida et al. [7] proposed a method to extract features terms from the customer reviews of e-commerce sites in order to recommend similar items to users. They used polarity analysis to calculate the degree of importance of feature words by counting the number of positive reviews, negative reviews, and positive ratings. In our work, we also use polarity analysis to evaluate advice topic words. However, we weight words according to the result of polarity analysis.

C. Query Generation

Song et al. [9] and Kajinami et al. [10] proposed a system to generate query keywords that can support a user's search intention. Kakimoto et al. [8] proposed a system to extract query keywords from the closed caption data of TV programs to recommend web pages related to tourism and events based on users' preferences. In our work, we extract query keywords from negative reviews to recommend web pages of advice with the aim of addressing a user's dissatisfaction with a certain service.

III. Proposed Method

A. Overview

In this paper, we propose a method to generate query keywords for users to search for advice according to their various complaints about a certain service. Figure 1 shows the system flow of our proposed method. First, we extract the company name and complaint topic words by calculating the importance of the nouns in the negative reviews. Second, we obtain candidate search keywords of these extracted words. Then, the system extracts the advice topic word by calculating the relevancy of the candidate keywords to the FKC dataset and score them using morphological and polarity analyses. Third, we create the query by combining the company name, complaint topic word, and advice topic word. These query keywords could respond to the needs and search intentions of different users in a comprehensive way. Finally, suitable web pages containing advice that could address a user's complaint are recommended from the results of the query.

B. Dataset

In this study, we analyze a dataset of complaints from the Fuman Kaitori Center, which is provided by Insight Tech Inc. from the National Institute of Informatics. In this paper, we refer to the Fuman Kaitori Center's dataset as the FKC dataset. The Fuman Kaitori Center is a website on which users can post their complaints about topics such as products, services, education, work, and relationships. Moreover, users get points when they post complaints that they can exchange for coupons for online shopping websites. This dataset contains about 5 million negative reviews that were posted from 18 March 2015 to 12 March 2017 by around 100,000 users. Each negative review contains the information shown in TABLE I. For example, the FKC dataset contains categories like "public transportation," "restaurants," and "industry." Each category contains several subcategories that describe the detailed information of the category. For instance, the category "industry" contains subcategories such as "agriculture," "architecture," and "IT web services." In addition, each subcategory contains several companies that are recorded in the dataset. Moreover, because we focus on user service complaints, we only analyze the data fields for "company" and "text" in the method proposed in this paper.

TABLE I
Details of the FKC dataset

Data item	Content
post_id	complaint ID
user_id	Fuman Kaitori Center ID
category	complaint category
subcategory	detailed complaint category
company	company name
product	product name
text	negative review

C. Extraction of Company Names and Complaint Topic Words

Our proposed method extracts company names from FKC dataset directly from the company field of each record. Next, we extract the complaint topic word by analyzing negative reviews. In this paper, we only use the negative reviews that are labeled with the company name. To extract complaint topic words, we first extract all companies' negative reviews for one subcategory. Then, we use morphological analysis to extract all nouns from the negative reviews. Next, we

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calculate the importance of each noun using the following equation.

$$\frac{tf}{|A|} \times \frac{tf}{\sum_{d \in D} tf_d} \tag{1}$$

Here, tf is defined as the number of occurrences of a particular noun in the complaints for a certain company, $|A|$ is defined as the number of all nouns in the complaints for a certain company, and $\sum_{d \in D} tf_d$ is defined as the number of occurrences of certain noun for the complaints for all companies. After calculating the importance of each noun, we determine the threshold value for that company. Finally, we extract all nouns whose importance values are above the threshold and define them as that company's complaint topic words.

D. Extraction of Advice Topic Words

To extract the advice topic word, we first obtain candidate search keywords from a Google search of the company name and complaint topic word. Because the FKC dataset is full of negative reviews, we hypothesize that candidate keyword that are less relevant to the complaint data will make better advice topic words. To verify this hypothesis, we calculated the relevance of these candidate keywords for each company and each complaint topic word. In this study, we define the "company relevancy" as the relevance between a candidate keyword and a particular company. It is calculated using the following equation.

$$company\,relevancy = \frac{R_{cd}}{R_c} \tag{2}$$

Here, R_{cd} is defined as the number of occurrences of certain candidate keyword in complaints for the company in the FKC dataset and R_c is defined as the number of negative reviews of that company.

Next, we define the relevance between a candidate keyword and a complaint topic word as the "complaint topic relevancy" using the following equation.

$$complaint\,topic\,relevancy = \frac{R_{td}}{R_t} \tag{3}$$

Here, R_{td} is defined as the number of occurrences of the candidate keyword with the complaint topic word in the negative reviews of the FKC dataset and R_t is defined as the number of negative reviews with that complaint topic word.

However, not all candidate keywords with low relevance in the FKC dataset can be used as advice topic words. For example, some negative words as well as verbs and adjectives do not help users acquire advice. Hence, it is necessary to exclude these kinds of candidate keywords. To do this, we weight candidate keywords using morphological and polarity analyses, as shown in TABLE II.

Finally, we calculate the final score of the candidate keywords by combining the arithmetic mean of the company and complaint topic relevancies with the weight as the following equation. Here, relevancies are calculated by adding the results of equation 2 and 3.

$$Score = \frac{relevancies}{2} \times Weight \tag{4}$$

TABLE II
WEIGHTS FOR CANDIDATE KEYWORDS

Result of Analysis	Weight
negative	0.8
verb	0.7
adjective	0.7
proper noun (place name)	0.7
proper noun (organization name)	0.3
common noun	0.3
verbal noun	0.1

After calculating the final score of each candidate keyword, we determine the threshold value for each company. Candidate keywords those scores are under the threshold value become the advice topic words.

E. Generation of web search queries

To respond to the different demands of users, each company name and complaint topic word are matched with several advice topic words. To search for suitable websites, We use an OR-based search method to acquire advice websites. Our proposed system generates the query based on one company name, one complaint topic word, and one advice topic word.

IV. Experiment and Evaluation

A. Dataset

In this study, we conducted an experiment to extract the complaint and advice topic words in order to verify the feasibility of proposed method. For this experiment, we analyzed the subcategory of "IT web services" of the FKC dataset, which is under the category "industry." We extracted 1,000 negative reviews for each of the six companies. The final dataset consisted of 6,000 negative reviews in total. And we analyzed three of the companies for experiment.

B. Experiment

First, we extracted the complaint topic words and determined different threshold values for each of the three companies. For company A, we extracted 186 complaint topic words above the threshold value of 0.00080. For company B, we extracted 144 complaint topic words above the threshold value of 0.00076. For company C, we extracted 86 complaint topic words above the threshold value 0.00080. Examples of the complaint topic words for each company are shown in TABLE III. These examples show that each complaint topic word implies the object of different users' dissatisfactions.

Next, we extracted advice topic words from the candidate keywords that had a score less than 0.0043, 0.0020, and 0.0033 for companies A, B, and C, respectively. We extracted advice topic words that match with 20, 10, and 10 complaint topic words for companies A, B, and C, respectively. Some examples of these words are shown in TABLE IV. As TABLE IV shows, even if the candidate keywords are under the threshold value, not all of them can be used as advice topic words. However, the proposed method is sufficient for ranking candidate keywords. Most of the extracted results

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TABLE III
EXAMPLE COMPLAINT TOPIC WORDS

Company	Complaint topic word
A	prime, delivery, movie, cardboard box, delivery fee, order, reservation, book, print, return
B	stamp, code, block, coin backup, telephone call, camera, setting, post, commercial
C	news, question, premium, answer, auction, article, title, ID, weather forecast, transaction

can be used as advice topic words. In the future, we plan to develop a method to determine a more accurate threshold value to better exclude noise in the results.

TABLE IV
EXAMPLE ADVICE TOPIC WORDS

Company name	Complaint topic words	Advice topic words
A	point	charge, present, how to save up, how to use, credit card
B	setting	security, Android, group friend, privacy, initialization, recommendation
C	premium	privilege, merit cancellation of agreement, softbank, magazine

C. Evaluation

We also conducted a questionnaire-based survey to evaluate whether the respondents thought that the query keywords extracted by the proposed method could address the dissatisfactions expressed in the negative reviews. Furthermore, we analyzed the usability and effectiveness of the proposed method. The questionnaire contains 20 negative reviews for companies A, B, and C. We then offered one query keyword generated by the proposed method and asked the respondents to judge whether this query could address the complaints found in the negative reviews using the following question.

Q1: Do you think the contents returned by a search using this query keyword could address the complaint expressed in this negative review?

D. Results and Discussion

We collected the answers of 10 respondents, and the results are shown in Figure 2. The results show that over 66% of the answers implied all query keywords provided in the survey would address the dissatisfaction expressed in the negative reviews. This result not only demonstrates that the query keywords generated by the proposed method could address users' complaints about certain services, but also implies the usability and effectiveness of the proposed method. Moreover, it is believed that the proposed method can respond to the demands of different users.

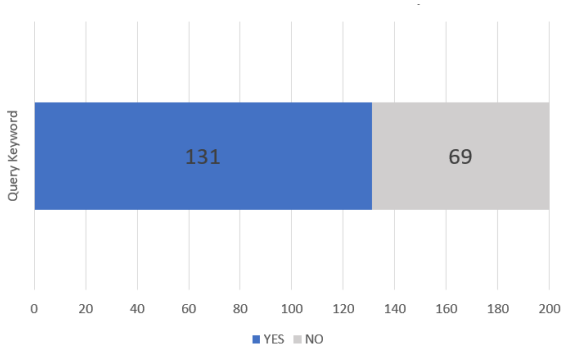

Fig. 2. Result of Questionnaire-based Survey

V. CONCLUSION

In this paper, we proposed a method to generate query keywords that will enable users to collect advice about a certain service. First, we analyzed the FKC dataset and extracted particular company names from the data. Second, we extracted complaint topic word that can express the dissatisfaction of users from the negative reviews for each company. Third, we extracted advice topic word that can help users to collect advice to address their complaints. Finally, we generated a query based on the company name, complaint topic words, and advice topic words. The advice on web pages returned by this query could address users' dissatisfactions with a service and respond to different user demands in a comprehensive way. In addition, we evaluated the effectiveness and usability of the proposed method through a questionnaire survey, and the results show that 66% of the answers thought the generated query keywords would be useful.

In the future, we plan to extract advice topic words by determining the threshold value in a more accurate way. In addition, we plan to conduct an experiment that analyses other companies of the subcategory of "IT web services" from the FKC dataset to extract other service complaint topic words and advice topic words. In addition, we are planning to evaluate the proposed method with another questionnaire survey. For this, first, we plan to evaluate if the complaint topic word could really represent a negative review's dissatisfaction or not. Then, we plan to evaluate the query keyword generated by proposed method by comparing with Google's candidate search keywords of company name and complaint topic word. Moreover, we plan to create a website that can automatically recommend advice web pages when users post their complaints on the website.

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