

An Advice Recommender System Based on Complaint Data Analysis

Liang Yang
Kwansei Gakuin University, Japan
dui93794@kwansei.ac.jp

Daisuke Kitayama
Kogakuin University, Japan
kitayama@cc.kogakuin.ac.jp

Kazutoshi Sumiya
Kwansei Gakuin University, Japan
sumiya@kwansei.ac.jp

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 an advice recommender system by analyzing complaint data from Fuman Kaitori Center. First, the system generates query keywords according to various user complaints about a certain service by calculating the score of each query. Then suitable web pages containing advice are recommended from the results of the query. This advice could address users' dissatisfaction and respond to their various demands in a comprehensive way. Also, we verify the usability of proposed system by using a questionnaire survey evaluation.

CCS CONCEPTS

• **Information System** → **Information Retrieval**; • **Query Processing** → *Query Suggestion*.

KEYWORDS

Recommender System, Query Extraction, Advice, Complaint Data

1 INTRODUCTION

In recent years, many users post negative reviews about a certain service online. However, it is quite difficult to respond to various user demands for service in real time as the service is provided by the company. In addition, there are almost no direct solutions when users feel dissatisfied with a certain service. Therefore, this paper is focused on user complaints related to services and proposed a system to search for advice that could address users' dissatisfaction by generating query keywords from complaint reviews[11]. This advice contains merits of the service users may not be aware of and could respond to their different demands in a comprehensive way. An example of advice recommendation is described in Figure1.

The remainder of this paper is structured as follows. Section 2 presents a brief summary of related work. Section 3 introduces the dataset we use for research and explains the proposed system. Section 4 discusses the experimental results and the evaluation of the proposed system. Finally, Section 6 concludes this paper and discusses future work.



Figure 1: Example of Advice Recommendation

2 RELATED WORK

2.1 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 determined the target of the experiment based on their results.

2.2 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 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.

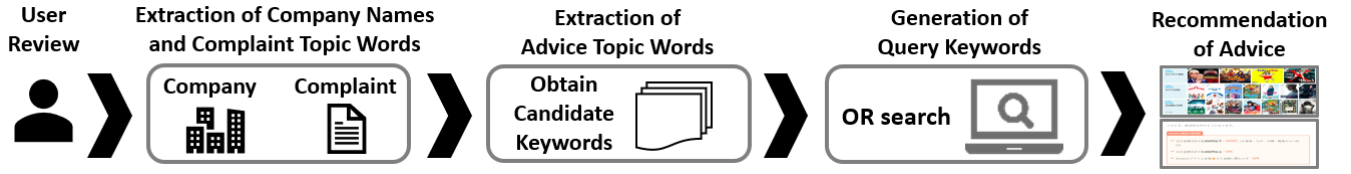


Figure 2: System Overview

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. In addition, we weight words according to the result of polarity analysis.

2.3 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.

2.4 Recommender System using Complaint Data

Hayashi et al. [3] proposed a system to recommend appropriate products for users according to their complaints. This system could directly resolve users’ dissatisfaction by recommending certain substitute product. In our work, we proposed a system to resolve user complaints about services instead of products in an indirect way.

3 PROPOSED SYSTEM

3.1 System Overview

In this paper, we propose a system by analyzing complaint data from Fuman Kaitori Center for recommendation of advice in order to address users’ dissatisfaction about a certain service. Figure 2 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 according to their various complaints about a certain service. Finally, suitable web pages containing advice that could address a user’s complaint are recommended from the results of the query.

3.2 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 1. In FKC dataset, each category contains several subcategories, and each subcategory contains several companies. In this paper, because we focus on user service complaints, our proposed system uses the data fields for “company” and “text”.

Table 1: Data Structure 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

3.3 Extraction of Company Names and Complaint Topic Words

Our proposed system 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 and extract all nouns from the negative reviews. Next, we calculate the importance of each noun using the following equation.

$$\frac{tf}{|A|} \times \frac{tf}{\sum_{d \in D} tf_d} \quad (1)$$

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

$\sum_{d \in D} t f_d$ is defined as the number of occurrences of certain noun for the complaints for all companies. Finally, we extract all nouns whose importance values are above the determined threshold value and define them as that company’s complaint topic words.

3.4 Extraction of Advice Topic Words

To extract the advice topic word, we first obtain candidate search keywords 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 FKC dataset 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 and define as “company relevancy” and “complaint topic relevancy”. It is calculated using the following equation.

$$\text{company relevancy} = \frac{R_{cd}}{R_c} \quad (2)$$

$$\text{complaint topic relevancy} = \frac{R_{td}}{R_t} \quad (3)$$

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. 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.

After that, to exclude some negative words as well as verbs and adjectives which do not help users acquire advice, we weight candidate keywords using morphological and polarity analyses, as shown in Table 2.

Table 2: Weight 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

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.

$$\text{Score} = \frac{\text{relevancies}}{2} \times \text{Weight} \quad (4)$$

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.

3.5 Generation of Web Search Queries

In this study, 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.

3.6 Recommendation of Advice

Our proposed system recommends suitable web pages containing advice from the results of the query which is based on users’ complaints. Figure3 shows the user interface of our proposed system. First, the system generates several queries by analyzing user’s negative review. Next, user can choose and browse the web page based on their needs by a web search using the offered queries. The system recommends the advice information that could address user’s dissatisfaction expressed in the negative review.

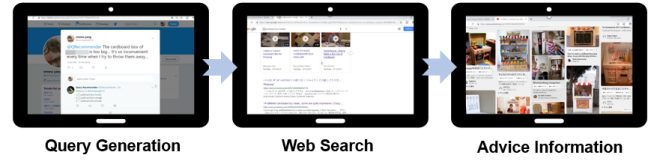


Figure 3: User Interface

4 EXPERIMENT AND EVALUATION

4.1 Experiment

In this study, we conducted an experiment to extract the complaint and advice topic words in order to verify the feasibility of proposed system. For this experiment, we analyzed the subcategory of “IT web services” of the FKC dataset, which is under the category “industry.” We analyzed 1,000 negative reviews for each of three companies.

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. Table 3 shows examples of the complaint topic words for each company. These examples show that each complaint topic word implies the object of different users’ dissatisfaction.

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. Some examples of these words are shown in Table 4. As TABLE 4 shows, the proposed method is sufficient for ranking candidate keywords.

4.2 Evaluation

In this paper, we conducted a questionnaire-based survey to evaluate the usability and effectiveness of the proposed method. The questionnaire-based survey contained following 3 questions. For

Table 3: Example Advice Topic Words

Company	Complaint Topic Words
A	purchase, prime, delivery, review, delivery fee, order, membership, return, post, gift, cardboard box, price, sign, yamato, book
B	stamp, code, block, coin, group, backup, lock, telephone call, camera, setting, post, input, message, content, commercial
C	news, question, premium, answer, auction, article, title, navigation, mail, shopping, ID, weather forecast, transaction, search, comment

Table 4: Example Advice Topic Words

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

Q1, we extracted all nouns from the negative review for respondents to choose from. For Q2, we provided 15 queries for each negative review to choose from. 5 of the queries' candidate keywords were made by ourselves. For Q3, we evaluated the satisfaction of the result of advice recommendation.

Q1: Please choose one word which you think could represent the dissatisfaction of the following reviews.

Q2: please choose the query that you think the contents returned by a search using this query keyword could address the complaints found in the negative review. (multiple choices are allowed)

Q3: Please make a web search with the queries you have chosen. Do you feel satisfied with the contents of the advice?

4.3 Result and Discussion

We collected the answers of 10 respondents, and the results are shown in Table 5 and Table 6. We defined those nouns and queries were chosen by over 5 answers as true positive.

Table 5: Result of Q1

	p@1
Average of p@k	0.60

The result of Q1 showed that if we search by using those nouns are with the highest value of importance for one time only, 60% of appropriate complaint topic word can be extracted from the

negative review. It not only shows that the proposed method is effective, but also explains the method to rank nouns by calculating the importance performed well.

Table 6: Result of Q2

	p@1	p@3	p@5
Average of p@k	0.70	0.67	0.60
Average of r@k	0.18	0.50	0.75
F-measure	0.28	0.57	0.67

The result of Q2 showed that if we search advice by using the query which is with the lowest score for one time only, 70% of appropriate queries can be offered to make web search in order to address the complaints expresses in the negative reviews. This result demonstrated that scoring candidate keyword is effective. However, we found out that the longer the candidate keyword was, the lower the score will be when making the candidate keywords. In the future, we plan to develop a method to ensure if the candidate keyword is related to the complaint topic word to better exclude noise in the results.

For Q3, the result showed that 75% of the answer felt satisfied with the contents of advice they searched with the queries they've chosen. From this result, it is observed that by using the proposed system could address users' dissatisfaction and the recommendation of advice respond to the demands of different users. Moreover, it implied by using proposed system can help users to release their burden when searching for advice comparing to traditional search engine.

5 CONCLUSION

In this paper, we proposed a recommender system by analyzing complaint data to recommend suitable advice. We extracted query keywords from various user complaints about a certain service by calculating the score of each query. Then suitable web pages containing advice are recommended from the results of the query. In addition, we evaluated the effectiveness and usability of the proposed system through a questionnaire survey, and the results shows that the generated query keywords would be useful for collecting advice. In addition, the recommendation of advice returned by query keywords could address users' dissatisfaction with a service and respond to different user demands in a comprehensive way.

In the future, we plan to evaluate the satisfaction of each query and analyze the result. Furthermore, we will consider new methods to obtain candidate query keywords which users are hard to associate to enhance the usability of the proposed system.

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