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Creating social intelligence for product portfolio design

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ABSTRACT

Increasing numbers of people are using social media to express their personal experiences. Recently, these plentiful user-generated data sources have been utilized promisingly by enterprises for product creation. In this research, we propose a social intelligence mechanism that can extract and consolidate the reviews expressed via social media and derive insights (product feature specification and feature importance) to help enterprises make decisions on developing next-generation products by analyzing the reviewers' knowledge and authority and their opinion sentiment toward the target products. The experimental results obtained using Epinions.com show that the proposed mechanism outperforms other benchmark approaches in market trend prediction and customer acceptance.

1. Introduction

Due to the rapid development of Web 2.0 technologies, the interactions between individuals have changed dramatically. More and more people are using blog, forum, and bulletin board systems to express their personal experiences. Gartner [13] reports that 40% of people usually search for products or services through social media, 77% of consumers read online reviews, and 75% of users trust online reviews more than personal recommendations. Nowadays, even strangers can easily exchange information through the Internet. A Nielsen Global Online Consumer Survey [31] indicates that 70% of people trust the online reviews posted by strangers. Online reviews have become a new and useful source for companies wishing to analyze people's opinions and infer their preferences. Enterprises can aggregate consumers' feedback to derive new strategies for product creation and design.

Social creation is a concept by which enterprises can utilize collective intelligence for new product or service creation. A survey conducted by OTX [32] shows that 71% of recommendations and information provided by consumers are valuable to companies. For example, Fiat, the most famous automotive brand in Brazil, built a website for people across the world to provide their opinions in a project called Fiat Mio. It received more than 10,000 suggestions from over 160 countries regarding the production of new cars. A popular e-commerce website, StyleFactory, displayed product images for customers to “make it” or “drop it” [28].

An enterprise can use a group of people to estimate the preference of the public. For example, enterprises usually construct a focus group or organize customer feedback within the company to understand customer needs for decision making [2]. On the other hand, the fiercely growing Internet provides an open and accessible resource to enable the enterprise to become closer to its customers. The online reviews are usually generated by consumers who have used the product. They explicitly or implicitly express their preferences or expectations regarding the next-generation products. Therefore, companies can analyze the reviews to enhance their products and produce new ones to match the needs of the majority of consumers. The next best-selling products will most likely be generated as a result of these insights from reviews [7]. Enterprises usually construct bulletin board systems or websites to allow customers to express their opinions conveniently. Although this method allows companies to collect customer opinions directly, the data are limited to specific aspects of a company. From a developer's viewpoint, understanding the whole market (including the competitors) is more important. Contrary to the specific channel of feedback collection, social media contain diverse perspectives of reviewers and constitute a superior choice for opinion collection. To achieve its goal, this research uses the concept of social creation, which utilizes social intelligence through the reviews expressed in social media to support product portfolio design. There are three main research questions to address in this research:

(1) How can firms identify the relevant information of quality from a large amount of reviews? In order to understand the market better and make better decisions, this study analyzes the reviewers' preferences and recognizes the people who have more related experience and knowledge regarding the target products.
(2) How can firms identify the influence of opinion expressers on online review websites? Opinion leaders are likely to influence the purchase intention or the preference of consumers for

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specific features. Therefore, the proposed approach aims to identify the opinion leaders, who have a powerful influence. Additionally, to discover the information of high influence produced by opinion leaders, the degree of relationship between reviewers should be measured to help enterprises make better decisions.

(3) How can firms consolidate the opinions from a number of identified reviewers? In online reviews, consumers usually express which features they like or dislike, but they cannot illustrate the scope of product specification that they would really like. Therefore, it will be beneficial to develop a mechanism that can extract and analyze customers' emotions regarding the specific feature and produce the scope of product specification. On the other hand, it would also be helpful if the proposed mechanism could predict the weight of each feature to help the developer set priorities for product development.

This research proposes a social media intelligence mechanism that can derive insights for enterprises to make decisions on next-generation product development. The generated insights include two parts: (1) inferred product feature specification and (2) product feature importance distribution. Specifically, inferred product feature specification analyzes reviews' content and recognizes the sentiments of the opinions to construct the scope of product specification [40]. The derived feature importance distribution shows how important a feature is when customers make purchasing decisions by ranking the importance of features in discussions. According to the insights, developers can evaluate the production cost and the selling price of the product to decide which feature should be added to the next-generation product first, and then formulate the development of product specifications.

The rest of the paper is organized as follows. Section 2 presents the related literature. Section 3 illustrates the system framework of the proposed social intelligence mechanism for product design. Section 4 describes the data collection, processing, and experiments. Section 5 demonstrates and evaluates the experimental results. Section 6 summarizes the research contributions and discusses the research limitations and future work.

2. Related literature

2.1. Product design process

For most of the enterprises, product design can roughly be separated into three main processes: concept definition, idea visualization, and mass-production [17]. Concept definition means to understand the similar products, competitions, sales of product, and the behavior of customer via market research. Idea visualization stands for expressing the concept of design through 2D drawing and 3D mock up. Mass-production aims to produce the product which is popular and competitive. There are plentiful studies in this field. For example, [8] focuses on the issue of concept definition. They construct emotional index and use data mining rule to measure consumers' preference. [14] studies the issue of idea visualization and uses a genetic algorithm to increase efficiency of the product design and use CAD to construct the prototype. This research focuses on concept definition. In the past, enterprises usually construct focus groups or organize the customer feedbacks within the company to understand customer needs for decision making [2]. An enterprise can use a group of people to estimate the preference of the public. Recently, prediction markets (PMs) have been applied in the domains of economics, politics, and sports. Researchers also used the concept to the evaluation of new product concepts, new product ideas and early stage technologies [9].

With booming social networking technologies, social media platforms have empowered Internet users to publish their creations and opinions and spread new content. In the past, messages were only delivered among friends. Nowadays, even strangers can search the information through the Internet easily. It also becomes a new way for company to collect people opinion and infer their preference. It is the concept of social design which means that enterprise aggregate consumers' feedback to devise new strategies, improve management flow, and reduce the risk. Abramovici & Lindner [2] analyze enterprise knowledge database established by enterprise customer feedback. Decker & Trusov [10] use product reviews data to infer consumer preferences.

However, previous researches did not consider interactions between people and their profiles. In this research, we use the concept of social creation (design) which combines the enterprise's design and the opinions in the popular social media to infer customers' preference to aggregate the social intelligence for enterprises to support product portfolio design.

2.2. Social creation

The concept of social creation is one type of co-creation, which is broadly defined as “creation of value by consumers” [41]. In the past, domain knowledge has been defined by and limited to a group of experts. The public only received experts' opinions, like those in Encyclopaedia Britannica. Nowadays, everyone who has domain knowledge can co-edit encyclopedias, like Wikipedia [21,38]. The co-creation mechanism transforms people's role from passive recipients to positive participants. It not only improves the efficiency of knowledge sharing, but can also help people to obtain a broader perspective of knowledge.

In the area of e-commerce, consumers are always the most important concern for enterprises. Any business strategies devised by enterprises should take consumers' perspective into account [3]. Hence, more and more companies are bringing consumers into the task of new product development. For example, IBM's Jam, a time limit online discussion platform, was developed to deal with the major issues of customer feedback. Another example is Polyvore, which uses an e-commerce website to collect information regarding consumers' combination of garments and shoes.

Although the concept of social creation in new product development has been proposed, the practical applications are still insufficient. Currently, most enterprises establish their own platform on which users can interact with each other. However, plenty of product and user preference information can be extracted from external data sources, such as the popularly emerging social media. This research focuses on exploiting the external opinions and reviews from social media and derives the social intelligence for new product design.

2.3. Feature selection

Due to the rapid development of web 2.0 technologies, more and more people use social media to express their personal experiences. Feature extraction methods are used to gather product features from a set of product reviews. Analyzing online reviews can help manufacturers better realize consumer opinions to their products and thereafter enhance their products [22]. Allan et al. [4] propose several techniques to discover relevant concepts and the topics of a query. The features of products mentioned in opinions are automatically identified by feature extraction. The authors of [16] generate a set of frequent features by finding out frequent terms and pruning the feature set by calculating term compactness and redundancy to extract product features. Abrahams et al. [1] developed a model of text classification and component feature selection for automatic product component categorization of online user postings.

The Red Opal system [35] also uses frequent nouns and noun phrases for feature extraction. The authors of [11] apply association rule mining mechanism to discover syntax rules of feature term occurrence, which could find out how frequently a feature term happens in some kind of syntax patterns. On feature-based opining summarization, Hu and Liu [15] propose Part-of Speech (POS) tag sequence rules to extract product attributes, and then the polarities of opinion words on