

# Ontology-Based Sentiment Analysis Model of Customer Reviews for Electronic Products

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## INTRODUCTION

This article reports on a generalizable system model design that analyzes the unstructured customer reviews inside the posts about electronic products on social networking websites. For the purposes of this study, posts on social networking websites have been mined and the keywords are extracted from such posts. The extracted keywords and the ontologies of electronic products and emotions form the base for the sentiment analysis model, which is used to understand online consumer behavior in the market. In order to enhance system accuracy, negating and enhancing terms are considered in the proposed model. As a result, it allows online businesses to use query to analyze the market trends of each product accurately based on the comments from user posts in social networking sites.

## BACKGROUND

### Popularity of Social Networking Websites

A social networking site is a website in which Internet users can gather and share information, develop friendships, and build professional relationships. Nielsen (2010a) stated that the average social networking visitor is now spending almost 6 hours per month in April 2010, versus 3 hours, 31 minutes in April 2009, an increase of almost 60% in one year. According to a recent survey more than half of all marketers are currently engaging in some form of social media activity with about 60% of them planning on increasing their

spending in the near future (Ramsey, 2010). After friends and family, the number one driver for brand trust is online reviews and feedback from social networking (Nielsen, 2010b). As a direct result, advertisers are moving from a more traditional broadcasting based marketing relationship with online consumers to a more interactive based marketing relationship, where consumers directly engage with marketing messages and pass them along to their friends via social networking sites (Gibs & Bruich, 2010). As a result, the social networking sites can greatly affect online consumers' buying decisions. Through social networking sites, Internet users can exchange information, thoughts and ideas about certain products or services. Through these sites, online companies can search informative material to help them analyze product trends in the market.

### Text-Mining in Social Networking Sites

Text mining emerged as a means to derive knowledge from unstructured data, especially data available on the World Wide Web. Mine, Lu and Amamiya (Mine, Lu & Amamiya, 2002) suggest a text mining system that obtains the relationship between the topics at international conferences. This experiment promises that the method works not only for obtaining the relationship between topics of conferences, but also for discovering the relationship between information entities that users are interested in. The issues regarding text mining have been discussed by Castellano and Mastronardi (Castellano, Mastronardi, Aprile & Tarricone, 2007) who have developed a web text mining flexible architecture, which can discover knowledge in a distributed and

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heterogeneous multi-organization environment. Pierre and Blondel (2008) offer ways for discovery of similar words from the WWW corpus. However both these works were based on text that follows a set of English grammar standard syntax. The mined information is therefore based on predetermined relationships using specific rules and ontologies. However, with the advent of social networking websites, a lot of information is in a non-rule based textual format. The usefulness of this information to determine social behavior is demonstrated by Java, Song, Finin and Tseng (2007). In view of this development, it becomes essential to extract behavioral patterns from relationships established using these data sources rather than predefined associations in ontologies.

## What is Ontology?

Ontology is defined as a set of representational primitives used to model a domain of knowledge (Noy & McGuinness, 2001). There is significant ontology-related research based on information retrieval (Java et al., 2007; Holger Bast, Fabian Suchanek & Ingmar Weber, 2008; Enkhsaikhan, Wong, Liu & Reynolds, 2007), which focuses on two areas: one is to excavate the unknown information using the intrinsic relationship between ontology concepts (Sam & Chatwin, 2005; Sam & Chatwin, 2010), the other is to use an ontology to classify the searched documents in accordance with the user's personal preferences in order to enhance the efficiency of query (Gao & Zhao, 2010). This research aims to offer a new ontology-based solution for semantic content retrieval based on users' queries.

## Sentiment Analysis

Sentiment analysis, also known as opinion mining, is the extraction of positive or negative opinions from (unstructured) text (Pang & Lee, 2008). Sentiment analysis has been used for many purposes; including predicting the outcome of an election (Wanner et al., 2009), detecting movie popularity from multiple online reviews and for many more scenarios. Sentiment analysis typically occurs in two or three stages, although more may be needed for some tasks (e.g., Balahur et

al., 2010). First, the input text is split into sections, such as sentences, and each section tested to see if it contains any sentiment: if it is subjective or objective (Pang & Lee, 2004). Second, the subjective sentences are analyzed to detect their sentiment polarity. Finally, the object about which the opinion is expressed may be extracted (e.g., Gamon, Aue, Corston-Oliver, & Ringger, 2005). Sentiment analysis normally deals with only positive and negative sentiment. In this research, the sentiment strength detection and the identification of both positive and negative emotions are taken into account. Several approaches have also been used to detect sentiment in text. One is to have a dictionary of positive and negative words (e.g., love, hate), such as that found in General Inquirer (Stone, Dunphy, Smith, & Ogilvie, 1966), Word-Net Affect (Strapparava & Valitutti, 2004), SentiWordNet (Baccianella, Esuli, & Sebastiani, 2010; Esuli & Sebastiani, 2006). In this research, HowNet, an online commonsense knowledge base unveiling inter-conceptual relationships and inter-attribute relations of concepts, is used to determine the similarity between the emotional keywords. There are mainly two reasons: 1) HowNet released both Chinese/English vocabulary for sentiment analysis in 2007 as it can be more flexible for expressing emotions in either one of the two languages; 2) the sentiment information has just been reinforced in HowNet (Dong & Dong, 2013) to enrich the vocabulary database.

## Semantic Similarity

HowNet is different from other semantic dictionaries and sememes are used in HowNet to describe every concept of each term. So the calculation of the semantic similarity has two hierarchies: the semantic similarity calculation of the words switches to calculations of the meanings, and the calculation of the meanings switches to calculations of the sememes.

Suppose there are two words,  $W_1$  and  $W_2$ . If  $W_1$  has  $n$  meanings

$$\{S_{11}, S_{12}, \dots, S_{1n}\},$$

$W_2$  has  $m$  meanings:

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