Abstract

The past decade has witnessed increased popularity of social networking systems such as blogs, forums, reviews sites etc. These systems provide a platform for web users to interact with other users across the globe and share information, opinions and/or experiences. Experiences or opinions about a product shared on these sites in the form of online product reviews play a crucial role in the competitive environment of e-market. These reviews express the strengths and weaknesses of each product with respect to functionality of its features or attributes and work as an e-WOM (electronic word of mouth) publicity for a product in Internet world. The influence spread through e-WOM has been recognized as an important decision making criterion in online shopping and hence is viewed as a new marketing tool.

A novel framework for targeted product promotional plan that takes the advantage of information shared through social networks has been presented. The presented approach applies firefly algorithm, a nature inspired algorithm, to dynamically capture the user interest towards product features. The algorithm is strategically employed to explore the social network of prospective consumers to identify the most influential customers termed as “initial seeds” for product promotion. The strategy is divided into three phases. In the first phase; the market analysis phase, the often changing market demands for a product feature and user preferences for the same are captured. The preferences of prospective customers are estimated by mining online product reviews shared over social sites. The varied product features expressed in these reviews are extracted by formulating syntactic rules. These extracted features are further pruned to identify set of significant features by feature selection approach. The most prominent method used for feature selection is rough set based attribute reduction (RSAR). But this needs an exhaustive search. Therefore the flashing behaviour of firefly algorithm is incorporated with the basic RSAR to improve its efficiency. Firefly algorithm best suits the scenario in study; as the nature of fireflies is similar to the trend followed by the consumers. In a market consumers are attracted towards influential co-consumers, just as fireflies are attracted towards fireflies emitting more light. The performance of the presented approach (FA_RSAR) was evaluated with respect to other heuristic, random search techniques such as Quick Reduct and Entropy Based Reduct
method. The efficacy was also evaluated with respect to other nature inspired algorithms such as GenRSAR, AntRSAR, PSO-RSAR, and BeeRSAR based on Genetic algorithm, Ant colony Optimization, Particle Swarm Optimization and Bee Colony optimization respectively. The experimental results substantiated the consistency and better performance of FA_RSAR as compared to other methods. The optimal subset of features (selected using presented approach (FA_RSAR)) that represent the original features with high accuracy was termed as most preferred features. The user interest estimated towards this set of preferred features forms the core of this approach. In the present scenario of WWW, users are categorized as either passive users or active users. Passive users passively read and consider reviews while purchasing a product. Thus their interest is captured by analyzing the time spent on each product review. In contrast to this active users actively participate and continuously shares their experiences and opinions for a product. A distinct feature based user profile is subsequently generated that implicitly extracts the most significant features for each user by mining their opinions. The performance of the presented profile generation approach was evaluated through an experimental study and the results substantiated the effectiveness of the approach. Based on users’ interest toward most preferred feature set, they are grouped into homogeneous segments in the second phase i.e. market segmentation. Market Segmentation is a process to divide whole market into relatively small market segments that consist of group of customers with similar product needs. The technique used for market segmentation is clustering. The simplest and the most popular algorithm used for clustering is \textit{k-means} algorithm. It is very efficient, due to its linear time complexity but the deterministic local search used in the algorithm sometimes leads to the nearest local optima. The prospects of firefly algorithm for clustering were studied to tackle this issue. The performance of the presented algorithm (FClust) was evaluated with respect to PSO (Particle Swarm Optimization) and DE (Differential Evolution) based clustering approaches. The experimental study proved FClust has a higher probability to achieve the optimality as compare to PSO and DE.

Thus FClust approach was used for market segmentation. Thereafter, for targeted product promotion the most potential segment(s) with respect to the product to be promoted is selected in the third phase i.e. targeted product promotion. However the selection of segment and the number of segments considered for product promotion depends on the type or features of product to be promoted and marketing budget. The presented approach focused on limited number of
initial users called seeds that have strong influence in the market to encourage faster adoption of the product throughout the entire network. Therefore the most influential seeds are identified by exploring the social connectedness among users of selected segments. A hybrid metric that combines the social behavior similarity and interest similarity between users is formulated to compute influential probabilities. These influential probabilities are then used to obtain $k$ most influential users that can maximize the influence spread where the value of $k$ depends upon the marketing budget. Maximizing the influence spread with limited seeding budget ($k$) in large network is denoted as $k$-Max-Influence Problem and proven to be NP-Hard. Therefore the viability of two prominent evolutionary algorithms i.e. Differential Evolution (DE) and Firefly (FA) for their suitability to $k$-Max-Influence problem vis-à-vis the contemporary greedy approach is explored. The results revealed that both evolutionary approaches DE and FA perform better as compared to Greedy approach with respect to maximum influence incurred as well as gain achieved by increasing the value of $k$. Amongst the evolutionary approaches FA maintained the consistency in its results and indicated higher probability to score over DE and Greedy based algorithms. The presented unified framework for targeted product promotion strategy using firefly algorithm on social network thus allows the organizations to target wide and right range of audience. The presented product promotion plan can be a boon in the marketing domain where organizations can use optimal company resources and efforts with limited budget to reach out to a vast potential segment.