Sentiment-Enhanced Content-Based System for Online Recommendations and Rating Prediction

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ABSTRACT

The scarcity of dependable product descriptions and limited emotion unmasking capabilities of user-ratings compromise the accuracy of content-based filtering (CBF) systems. This work puts forward a sentiment-enhanced content-based recommender system (SEC-Rec). The model has four modules, namely key feature extraction module, feature sentiment analysis module, recommendation module, and rating prediction module. Key feature extraction module uses hybrid of RAKE and TextRank to uncover key product features. The authors propose a hybridized model HSVADER (Hybrid SVM and VADER) for feature sentiment evaluation. The recommendation module combines sentiment and similarity for robust product ranking strategy. The practical benefits of SEC-Rec are demonstrated using Amazon Camera dataset, and the results are compared to the state of the art. The rating prediction module uses key feature sentiment score to estimate the overall user-rating resolving the multi-criteria decision-making issue. The RMSE value obtained ascertains the effectiveness of the approach compared to recent models.

KEYWORDS

Content-Based Recommender System, Multi-Criteria Decision Analysis, Sentiment Analysis

INTRODUCTION

The colossal growth in digital information and the number of visitors on the Internet has led to a complete transformation in e-business environment. Big data has revolutionized business analytics for better modelling of customer profiles, customer-relations and satisfaction. The big data movement seeks to glean intelligence from data and translate it into business advantage. But the pertinent upheaval of data has uncovered myriad challenges, the most important of them being searching for relevant data. Due to this, recommendation systems (RS) have started playing a major role in our lives. From e-commerce to online advertising, recommender systems are inescapable in the
present online environment. A recommendation system recommends products and services to users by exploiting their interest patterns and purchase decisions (Chen, Yang, Zhou et al., 2018). RS are ubiquitous with applications like recommender systems for movies (Carrer-Neto et al., 2012), tourism (Lim et al., 2016), music (Bogdanov et al., 2013), research articles (Son & Kim, 2018) etc. Product recommendations majorly rely on two factors, user ratings and product descriptions. For example, collaborative filtering methods (CF) (Schafer et al., 2007) exploit user-rating trends to decipher user-user similarity patterns. Whereas, content-based filtering methods (CBF) (Pazzani & Billsus, 2007) manipulate product descriptions to recommend products similar to the ones liked by target user. Each of these approaches have their own advantages and disadvantages and are often used in coalescence for enhanced performance results.

Social Web 2.0 has led to an upsurge in user-generated content which has essentially changed the online ecosystem. The increasing popularity of sentiment-rich resources like online feedback systems and personal blogs has made electronic word of mouth even more powerful. In the present setting, user reviews have started playing a vital role in determining the usability of product. More recently research interests have shifted to the orchestration of experiential user information (extracted from social web) for improved recommendation quality. In order to determine whether the reviewer’s attitude towards a particular product is positive, negative, or neutral, sentiment analysis can be used. Sentiment analysis is a text categorization technique that interprets and classifies people’s opinions, appraisals, emotions, and attitudes towards entities like products, services, organizations, events, topics and their attributes. (Liu, 2012). Sentiment analysis can be used as an augmentation to the current recommendation systems, to automate product evaluation for ministration of purchase decisions.

CBF is a widely used recommendation technique that highly depends on availability of detailed and dependable item descriptions. Several techniques like matrix factorization (MF), probability models, nearest neighbour methods and clustering etc. have been used to augment CBF for superior results. Although traditional CBF techniques are efficient and easy to implement, they still suffer from a number of drawbacks like low prediction accuracies, lack of dependable item descriptions and inability to capture complex user-item interactions (Nassar et al., 2020). Also, classic catalogue-based item descriptions are unable to uncover factors that manipulate user purchase judgements. This leads to the multi-criteria decision problem of determining and combining estimators for rating prediction to quantify user-adherence for a product. All these drawbacks have opened avenues for exploring multi-criteria recommender systems (Nassar et al., 2020), deep learning and soft-computing based RS (Fu et al., 2018) for performance enhancement.

Faced with the two-fold need to firstly retrieve useful experiential description from user-generated feedback and secondly to combine estimators that modulate purchase decisions, this study proposes a sentiment enhanced content-based recommender (SEC-Rec) system for product recommendations and rating prediction. The model reinforces feature engineering with sentiment analysis to uncover key factors that impact purchase choices. Sentiment scoring of key features facilitates robust product recommendations that garners intelligence from user reviews. Implicit features (derived from user experiences) are extracted from user-reviews using hybrid TextRank (Mihalcea & Tarau, 2004) and Rapid Automatic Keyword Extraction (RAKE) (Rose et al., 2010). The key features hence obtained are sentiment scored on a fine-grained scale using a novel sentiment analysis model Hybrid SVM and VADER (HSVADER). Sentiment scored key-features are used to populate sentiment rating matrix (SRM). SRM is a representative of dependable experiential description that is further exploited for content-based recommendations. Additionally, the feature sentiment scores are judiciously combined to predict user-product adherence (product ratings). The results evidence that the selected features are good estimators for quantifying user’s interest in products and feature sentiment ratings are a dependable scoring metric for these estimators. The key contributions of this system are:

- The proposed model SEC-Rec explores the utility of experientially rich user-generated content as an alternate to classic catalogue descriptions for sentiment-aware content-based recommendation;
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