Customized Online Shopping for Clothing using A Knowledge-based Recommender System

Hla Hla Moe, Moe Sanda Htun
Computer University (Sittwe)
hla2moe@gmail.com, moesdhtun@gmail.com

Abstract

Within the past few years, a large variety of online stores has been started in cyberspace and people face the problems to get some things which they really want or need. Recommender systems help them to solve these problems. Thus, recommender systems are becoming popular to use in various online companies. Simultaneously, personalization becomes popular, too. By using enough knowledge about the preferences of individual customer, it is possible to provide personalized services to get more customers. This paper describes an implementation of personalized knowledge-based recommender system, recommending the most appropriate items for each customer to support an adaptive clothing company. In this paper, knowledge base and forward chaining algorithm are used as the inference engine from the company to get the best results.

1. Introduction

The development of Web technologies has brought a lot of advantages to merchants for moving their business on line. One important factor determining the success of on-line stores is whether the on-line shopping experience can be enhanced to such an extent that some customers choose to and continue to shop on-line. Along this direction, the concept of personalization has long been advocated as one of the edges to improve the stickiness of on-line stores. Customers are more likely to purchase from a site that allows personalization, and register at a site that allows personalization or content customization. To achieve that, an on-line store needs to be enabled with adequate knowledge about customers' preferences characteristics and use it effectively to provide personalized services with high precision. A typical example of personalized services is the use of recommender systems [1, 4].

Today, personalization [1, 3, 6, 9] is something that occurs separately within each system that one interacts with. Personalization can be applied through different mathematical methods like collaborative filtering or by using intelligent system like what is known as recommender system [9]. Recommender systems [1, 2, 4, 6]are one technique for personalization; in essence the personalization occurs slowly as each system builds up information about user's likes and dislikes, about what interests him and what fails to interest him..

Recommender systems support users by identifying interesting products and services in situations where the number and complexity of offers outstrips the user's capability to survey them and reach a decision. Interest in recommender systems has dramatically increased owing to the demand for personalization technologies from large, successful e-commerce applications [8, 10]. Typically, they use an intelligent engine to mine the customer's rating records and then create predictive user models for product recommendation [1].

There are three basic approaches to the implementation of recommender applications.

- Collaborative - user models are created solely by utilizing overlap of user preference ratings,
- Content-based - user models are created implicitly by applying machine learning or information retrieval techniques to user preference ratings and features extracted from product description and
- Knowledge-based - user models are created explicitly via a knowledge acquisition process [1, 2, 4].

The goal of all the types of recommender systems is to attract new customers and retain the old ones by offering a more enjoyable browsing experience and to increase the overall sales volume.

But, if a company is lacking such ratings information or it has new items arrived constantly, collaborative and content-based approaches will fail. Therefore, this system uses knowledge-based approach to avoid these problems. The system is designed to support an adaptive online clothing company in providing

customized recommendation services and to help finding the best items for each user based on their preference and available money.

2. Related Work

Some online shopping recommender systems are developed by collaborative and content-based methods. Some such as Amazon.com and CDNow.com are implemented by various data mining rules [1, 7, 10].

Brendon Towle and Clark Quinn developed Knowledge-based recommender systems using explicit user model to solve both the early rater problem and sparse rating problem [11].

Rayid Ghani and Andrew Fano from Accenture Technology Labs in Chicago presented a case study of a system that recommends items based on a custom-built knowledge base that consists of products and associated semantic attributes. This allowed users to explain the recommendations in terms of quantitative features to enhance the user experiences and help build the user's confidence in the recommendations [4].

Fiona Y. Chan and William K. Cheung from Hong Kong Baptist University used the feature vector-based representation to develop the knowledge-based customized recommender system [1].

Knowledge base and inference engine are two important components of knowledge-based systems. In the rule-based system, the knowledge base is represented in the form of a set of if-then rules and forward-chaining reasoning is used in the inference engine.

Forward Chaining approach [3] is a problem solving paradigm that in many respects is different from other major AI approaches. Therefore, this system uses Forward Chaining method to get the personalized clothing for individual user.

3. Knowledge-based Recommender Systems

In shopping system, customers purchasing complex products such as computers, clothing or furniture need both information and intelligent interaction mechanisms that support the selection of appropriate solutions. So, an explicit representation of product, marketing, and sales knowledge is necessary. Knowledge-based approaches [5, 10] use this type of representation. In particular, explicit knowledge representation enables the validation of a recommender system's quality regarding calculated solutions.

Two basic aspects [2, 4, 5] must consider when implementing a knowledge-based recommender application. First, the relevant set of products (or services) has to be identified and transformed into a corresponding formal representation, i.e., a recommender knowledge base has to be defined. Second, a model of a recommender process must be defined which serves as the basis for the execution of customer-specific dialogs based on personalized navigation paths through a recommender application.

In this system, the recommender knowledge base is constructed by the following steps.

1. Collect information about items
2. Define the set of features to be extracted
3. Label the data with values of the features defined in step 2
4. Train a classifier to use the labeled training data to extract features from unseen data
5. Extract features from products by using the trained classifier
6. Populate a knowledge base with the products and corresponding features

And then, the recommendation process of the system is the following.

1. Watch the user browse items
2. Extract the product name and description
3. Infer features from new products by using the trained classifier
4. Build a user profile in terms of these semantic features
5. Recommend items from the knowledge base that match this user profile

The system deals with products in the domain and extracts a predefined set of semantic features for each item. These features can generally be extracted from any text materials designed to appeal to a consumer's taste (likes or dislikes).

3.1 Background Method

Forward chaining [3] is used as the background method of the system. Forward Chaining starts with the data available and uses the inference rules to conclude more data until a desired goal is reached. An inference engine using forward chaining searches the inference rules until it finds one in which the if-clause is

known to be true. It then concludes the then-clause and adds this information to its data. It would continue to do this until a goal is reached. Because the data available determines which inference rules are used, this method is also called data driven.

To apply the forward chaining algorithm in the knowledge-base recommender system, some attributes are required. Using theses attributes, the system sets the appropriate rules to generate the personalized recommendations which the users actually need or want. In this system, the following attributes for individual user are used.

- Marital status
- Gender
- Prefer style
- Prefer color
- Age
- Size
- Salary

These attributes have the corresponding facts to set the appropriate rules. For example: Gender is considered based on male and female.

To recommend the best results for each customer with his/her preferences; the system defines a set of rules with forward chaining using attributes as follow:

For example:

Rule1: IF Gender = Female
AND Prefer-style = Modern
AND Prefer-color = Pale
AND Salary = between 50000 and 100000
AND Size = Medium
THEN Recommend-type = Modern-Pale-Level-Medium-Women's wears

Rule2: IF Gender = Female
AND Prefer-style = Simple
AND Prefer-color = Pale
AND Salary= between 50000 and 100000
AND Size = Medium
THEN Recommend-type = Simple-Pale-Level-Medium-Women's wears

Rule3: IF Marital-status = Simple
THEN Recommended-for = Only User

Rule4: IF Marital-status = Marriage
THEN Recommended-for = Couple and Children

If given attributes are followed with Rule1 and Rule3. Then, the system recommends Modern-Pale-Level1-Medium-Women's wears.

If given attributes are followed with Rule1 and Rule4. Then, the system recommends Simple-Pale-Level1-Medium-Women's wears, Men's wears and Kid's wears.

There are many rules which are used in this system as the above example to recommend the user according their preferences and the best recommendation is given.

4. Architecture of the System

In this system, user will have to provide his/her personalized preferences to the system. The system stores and updates these preferences as the user's profiles in the knowledge base. In the knowledge base, training data (product name, product category, product style, product color, age-level, purchased price, sale price and product image) collected by crawling websites of apparel retailers are stored. To test the training data, the system uses the following facts or values.

To test the training data, the system uses the following facts or values.

Table 1: Features and their Values

Feature Name	Facts or Values
Product Style	Formal, Simple, Modern
Product Color	Pale, Dark, Mix
Age Level	0(Under 16), 1(16 to 23) 2(24 to 40), 3(Over 40)
Sale Price	<=10000, Between 10000 and 25000, Above 25000

The system starts to discover and analyzes with the training data in the knowledge base and sets the rules using forward chaining to search appropriate clothing with user's preference. The system uses testing data to test the accuracy of the rules with real market. After searching clothing in the stores with these rules, the system generates personalized recommendations and cost of clothing and recommends to the user. The architecture of the system is as shown in figure 1.

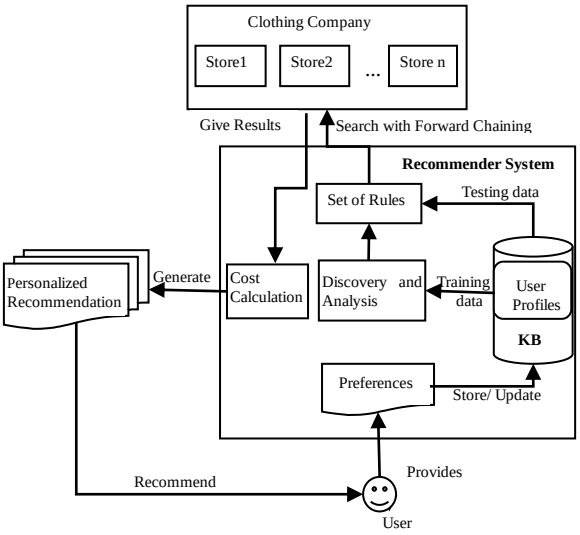

Figure 1: System Architecture

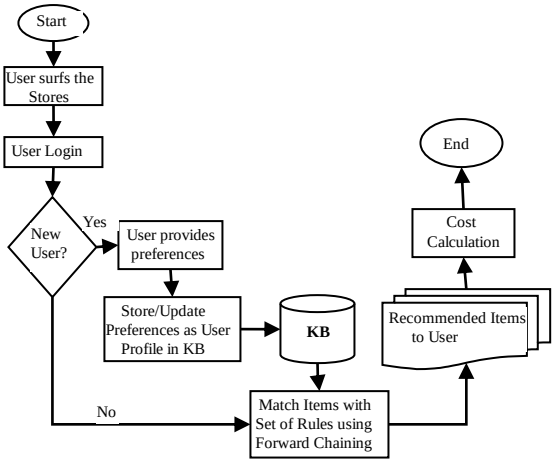

Figure 2: Process Flow of the System

4.1 Implementation of the System

This system is an implementation of Customized Online Shopping for Clothing using a Knowledge-based Recommender System.

This system provides many clothing categories. For men, a customer can get Coats, Jackets, T-Shirts, Shirts, Jeans wears, Pants, Longyi and Extra things. For women, one can buy Coats, Jackets, T-Shirts, Shirts, Jeans wears, Pants, Longyi, Skirts, Dresses and Extra things. Moreover, the system provides many kid's wears.

The system consists of the following processes. At first, the user enters the system by User Login. If the user is a beginner, the user will have to register to provide his/her preferences. The system stores and updates these preferences in the knowledge base as user profile. Then, the system finds and matches the items with set of rules using forward chaining and calculates the cost of all items user chosen. At last, the system gives personalized recommendation to the user. Figure 2 is the process flow of the system.

This system is implemented as online shopping recommender system and developed using Microsoft Visual Studio 2008 with ASP.Net C#.

4.2 Components of the System

The system has the four main components:

- User profiling module – acquires the user demographic information via a simple questionnaire during membership registration and transforms the information to create a subsequent matching. To keep as a user profile in the knowledge base, the system requires the following personalized knowledge:

-User demographic information, e.g., gender, age, occupation, etc. and
-User preference profiles, e.g. price, color, dressing style, etc.

- Product characterization – based on a chosen set of features, product characteristics must create for all the products**.** The knowledge required to be acquired and stored in the knowledge base for driving this customized on-line store include:

-Generic products information, e.g., product name, cost, sale price, etc.

-Product characteristics, e.g., category, color, style, etc.

- Matching engine – given the user preference profile, the product characteristics and the range of preference values, a set of rules can then be defined using forward chaining approach and compares the rules between user preference profiles and product characteristics to support personalized product.
- Cost calculation – is to calculate the cost of user selected items. At first, it is collected the items that user has chosen in

the shopping cart and then it calculates the total amount of money of the collected items.

4.3 Advantages of the System

This system presents an approach of forward chaining with a specific target predicate in the heads of the rules. In online shopping, getting products with multiple attributes and multiple prices, user might have difficulty in finding the right product he/she actually wants or needs within his/her preferences. This system will carefully balance to satisfy the buyer's really needs including his/her preferences. With this system, it can solve the problem of information overloading, the rating problem and recommending the right product for the each user by specifically considering incremental building of knowledge about the products, users or customers.

5. Conclusion

To sum up, this system is an implementation of customized online shopping and calculating the cost of buying items for the users using a knowledge-based recommender system. The system recommends the best items to the user after user had indicated their shopping preferences to the system. It can be more effective at recommending products when we go beyond the immediately available data, such as the fact that a customer is looking at or bought a product. Therefore, users can save of time in searching required information and able to select from the most suitable products. The system is believed that the best way of evaluation is to apply it to the real market.

6. References

[1] C. Fiona and C. William , "*A Knowledge-based Recommender System for Customized Online Shopping*", Department of Computer Science, Hong Kong Baptist University, Kowloon Tong, Hong Kong

[2] F. Alexander and S. Kostyantyn , "*Debugging User Interface Descriptions of Knowledge-based Recommender applications*", University Klagenfurt, Austria

[3] F. Ronen , "*FRST _An Interactive Revision System for Forward Chaining Rule Bases*", Math and Computer Science Department, Bar-Ilan University, Ramat-Gan Isreal

[4] G. Rayid and F. Andrew, "*Building Recommender Systems using a Knowledge Base of Product Semantics*", Accenture Technology Labs, Chicago

[5] G. Yuanbo, P. Zhengxiang and H, Jeff , "*An Evaluation of Knowledge Base Systems for Large OWL Datasets*"**,** Computer Science and Engineering Department, Lehigh University, Bethlehem, USA

[6] L. Clifford, "*Personalization and Recommender Systems in the Larger Context: New Directions and Research Questions*", Coalition for Networked Information, Washington, DC, U.S.A

[7] L. Liu, "*Research on Recommender Systems in E-commerce*", BeiHang University

[8] M. Stuart Edward, "*Capturing Knowledge of User Preferences with Recommender Systems*", University of Southampton

[9] O. John and S. Barry, "*Trust in Recommender Systems*", Adaptive Information Cluster, Department of Computer Science, University College Dublin, Ireland

[10] S. Lars, F. Alexander and F. Gerhard, "*Recommender Systems*", University of Klagenfurt and University of Hildesheim

[11]T. Brendon and Q. Clark, "*Knowledge Based Recommender Systems Using Explicit User Models*", Knowledge Planet.com, Emeryville