Bridging the Gap Between Users and Recommender Systems: A Change in Perspective to User Profiling

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Abstract One of the prevalent research challenges in the field of recommender system is to do better user profiling. There are some advanced user profiling techniques found in the literature to achieve the same. User profiling aims to understand the user well and as a result recommending the most relevant items to the user, where relevant means items returned as a result of intelligent techniques from various fields, mainly from data mining. This work is an attempt to answer the question "who understands a user the most?" The three obvious answers are Recommender System's high end approaches (e.g. data mining and statistical approaches), neighbors of the user or the user herself. The correct answer would be the last one, which is a user knows herself the best. In this direction, we propose to make users empowered and responsible for registering their preferences and sharing the same at their discretion. More personalized solutions can be offered when a user tells what she prefers and can contribute explicitly to the recommendation system's results generation. When a user is given the handle to communicate her preferences to the recommender system, more personalized recommendations can be given which are not only relevant (as tested by sophisticated evaluation matrices for recommender systems) but also plays wonder to users' satisfaction.

1 Introduction

Recommender System as a research field flourished well with many techniques and features borrowed from other disciplines. Some of these disciplines are data mining, statistics, psychology and human computer interaction (HCI). Recommender Systems as an applicative area of data mining are used to recommend users in an online world, a few highly relevant items from a vast pool of available options. A significant research

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and development is seen in recommender system field. This work is an attempt to re-visit the field again in quest of finding some unseen/ underdeveloped opportunities specifically to do better user profiling.

When we talk about Recommender System, we observe three core entities involved in a typical e-commerce interaction as mentioned below (refer Figure 1):

a User
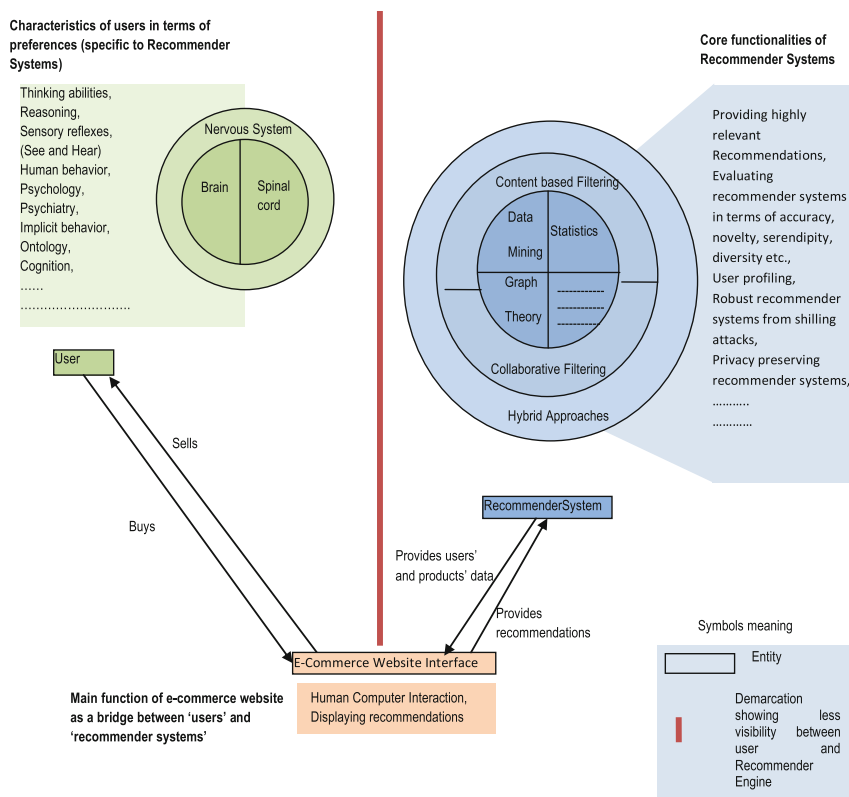b E-Commerce Interface
c Recommender System

This work is an attempt to closely view how to strengthen relationship between user and recommender system. In order to understand the user, Recommender System does user profiling. Categorically, we can say that most of the work is being done in Recommender System side to improve it.

In the initial days when e-commerce sites were evolving, it is being assumed that users of e-commerce site are not educated/ trained enough, so all the intelligence were being employed on the Recommender System to understand the user. Since then, the major efforts are made in the direction to understand the user better. In technical terms, it is called *user profiling.* All the data mining and statistical techniques that are employed in recommender system are primarily focused to understand the user better in order to give her appropriate recommendations.

The primary reason that researchers focused only in the direction of Recommender System to understand the user was they assumed that "User cannot express herself". So, all the prevalent techniques devised intelligence in Recommender System's side to understand the user. But today users are well versed with the internet; they are educated enough and understand well the dynamics of internet. They are empowered and they want a custom made solution for themselves, rather than a generic solution. In technical terms, it is called *personalization.* Moreover, they want their inputs being incorporated in any decision making (in this context recommendations). After going through extensive literature review, we found that following work are being done in Recommender System (refer figure 1).

The user can see the recommendation on an e-commerce website. There is almost no transparency between recommender system and the user. A user always has following questions in her mind with respect to recommender system.

i. Why she needs to create multiple profiles on different e-commerce sites? Is there any way to write preference only once and use everywhere (across multiple e-commerce websites)?

ii. How the recommendations are generated for her? Is it based on her preference or based on her neighbors?

iii. Who all/ (how many) people have rated the product before being recommended to her?

iv. In determining the overall rating of the product, how many people have actually bought the product?

v. Are the profiles who have rated are genuine profiles or attackers?

Characteristics of users in terms of
preferences (specific to Recommender
Systems)

Thinking abilities,
Reasoning,
Sensory reflexes,
(See and Hear)
Human behavior,
Psychology,
Psychiatry,
Implicit behavior,
Ontology,
Cognition,
......
....

Nervous System

Brain | Spinal cord

User

Sells

Buys

Content based Filtering

Data Mining | Statistics

Graph Theory | ------------ / ------------

Collaborative Filtering

Hybrid Approaches

Core functionalities of
Recommender Systems

Providing highly
relevant
Recommendations,
Evaluating
recommender systems
in terms of accuracy,
novelty, serendipity,
diversity etc.,
User profiling,
Robust recommender
systems from shilling
attacks,
Privacy preserving
recommender systems,
....
....

RecommenderSystem

Provides users'
and products' data

Provides
recommendations

E-Commerce Website Interface

Main function of e-commerce website
as a bridge between 'users' and
'recommender systems'

Human Computer Interaction,
Displaying recommendations

Symbols meaning

☐ Entity

❚ Demarcation
showing   less
visibility   between
user   and
Recommender
Engine

Fig. 1 Bird's Eye view of a typical e-commerce interaction

Our research questions are also pointing to the above user concerns.
Definition of the problem

Empowering a user to receive more personalized recommendations by giving her handle to create and share her profile at her own discretion using "user agent". Hence augmenting the existing intelligence mechanism by incorporating users' intelligence.

This work mainly focuses to answer the following research questions:

RQ1. How to make users of e-commerce sites speak about her preferences?
RQ2. How to centralize and store users' preferences which are collected at different e-commerce websites and synchronize it with each e-commerce website? i.e how can we facilitate write once use everywhere paradigm?
RQ3. How to make recommendation process more user-oriented (in terms of her satisfaction on seeing the recommendations as well as her involvement in final recommendations)?

RQ4. *Are user's neighbours found through collaborative filtering actually determines her preferences well? Or the users preferences captured explicitly contribute more towards profiling her?*

Following are the key contributions of the work:

i. User can express herself. We equip the user to define her in addition to applying intelligence (at recommender system entity, refer figure 1) to understand the user.

ii. User empowerment by her contribution in decision making in recommendations given to her.

iii. User wants custom made solution which is provided through collecting even those preferences which she can't put forward verbally (implicit preferences).

iv. User's overall transactions on all e-commerce are considered to build her profile and the same will be propagated to every e-commerce website through synchronization by user agent.

v. Offering serendipitous yet relevant recommendations.

2 Proposed Approach

Considering the fact that now internet users *"can express themselves"*, so, in addition to applying intelligence at the recommender system side to understand the users, why cannot we give the handle to the user to express herself, build her own profile, decide who are her neighbors with respect to recommender system.

The second challenge and frustration for the users of an e-commerce site is that she has to build her profile and set her preferences in every e-commerce portal *(Flipkart, Jabong, Amazon* etc.) and irrespective of overall transactions that she has done only the transactions that has been done on individual e-commerce site will be counted for building and enriching her profile.

E.g. Consider a scenario in which a user has done 100 transactions overall that spans across 5 e-commerce sites. All the transactional details will not be available with each e-commerce website and despite of 100 transactions only the local transaction with respect to the website will be considered and recommendation will be based upon those local transactions. If she has done only 2 transactions on a particular e-commerce website, despite of her 100 transaction only 2 transactions will be considered for decision making (Recommendation). This is really annoying for users as their profile preferences are not synchronized.

Our proposed approach addresses above said prevailing challenges and also empowers the users to contribute in the final decision making (Recommendation) process. In this era of internet we have to come out of the stereotypical thought "A user cannot express herself" and user is not educated enough with internet. All the existing Recommender systems seem to be made on the assumptions that the "User cannot express herself" (refer Figure 2).
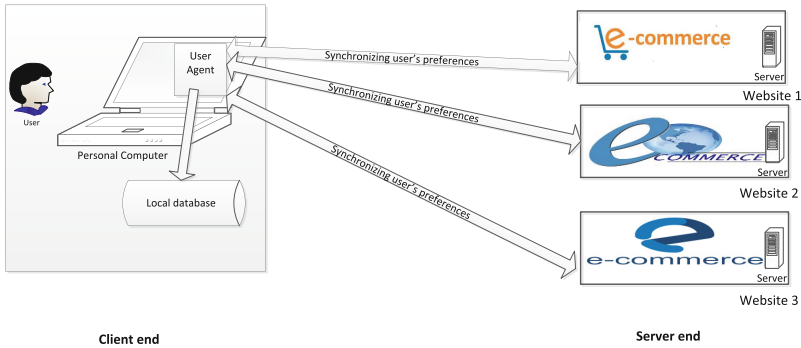
Fig. 2 User agent synchronizing user's preferences across different e-commerce websites

2.1 Typical Web Interaction of an E-commerce Site:

An e-commerce application is typically a web application and the client accessing the e-commerce application is thin client, where almost no processing is being done on the client side. Thin client is just used to render the html content which is returned from the e-commerce server.

In our proposed approach, we are advocating for a "thick client" to do better user profiling and empowering the user to enrich her profile, preferences, control the kind of recommendation she wants. In a nutshell empowering the user in recommendations and augmenting the intelligence of recommender system for appropriate recommendations to the user.

In addition to empowering the user, these thick clients will address the issue of building multiple profiles, preferences and transactional history in every e-commerce site. The user need to build her profile and preference object only once on thick client and then she can synchronize these profile and preferences object with every e-commerce website with which she wants to interact. In this way a rich transactional history will be available to each e-commerce website, hence improved decision making with respect to recommendations.

2.2 User Agent at Client's end

The user agent installed at the client end will capture the user's browsing patterns, implicit behavior based preferences and her explicit preferences. This will ensure every minute preference of a user to be captured. It is not possible for the user to express all her preferences explicitly, so some intelligent techniques are employed to capture implicit preferences as well. For example, user can explicitly say she likes a particular product, but when she sees it, she comes to know whether she wants that. Similarly, she may like something she has not explicitly expressed. User unconscious preferences are required to be captured for better user profiling. These preferences when used to recommend are serendipitous as well as useful to the user.

Sharing the preferences by this process would be at users' discretion. Users who need enhanced personalization can be benefited from this approach.

At present, the recommender system, tries to *pull* the information from the users to understand her well. This *pull* approach is depicted in figure 3, where recommender system pulls user information by anticipating, mining techniques and intelligent algorithms. The advancements done in pull approach though offers high quality recommendations but here, the user is suppressed and considered as mute entity.
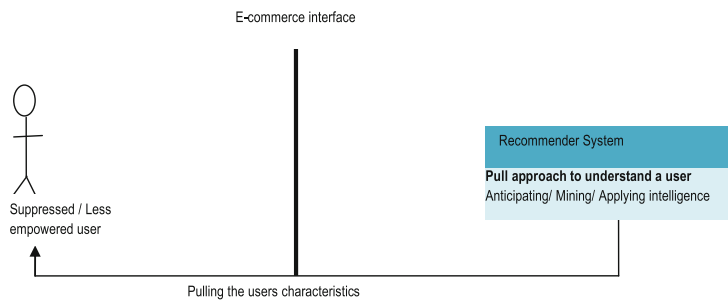
Fig. 3 Present Scenario: Pull approach by recommender systems towards user

We propose that a user is a key entity in recommendation process, which calls to make her more empowered. In other words, let her speak for herself. Let her push her preferences through user agent to the recommender system. User agent synchronizes user's characteristics with every e-commerce portal. This is a *push* approach, depicted in figure 4.
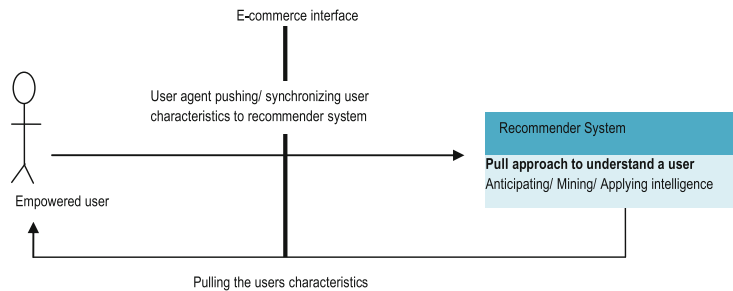
Fig. 4 Proposed solution: Push approach by user to recommender system

The existing recommender system's *pull* along with augmented user's *push* results in better recommendations.

2.3   Proposed Solution is an Augmentation to the Existing Intelligent Approaches

Recommender system entity (refer figure 1) is evolving and many intelligent techniques and algorithms have been developed so far. The proposed solution is an augmentation to existing intelligent mechanism in recommendation process. The proposed work highlights how a suppressed entity (a user) can be empowered to share her preferences at her discretion and the benefit of this approach.

3   Related Work

The concept of personalization plays a key role in recommender systems' designing and development. More useful recommendations must be personalized or tailor made for a user. User profiling deals with understanding users' more closely so as to provide them customized solutions. User profiling is about identifying and mining data about a user's interest domain. For accomplishing this, advanced modeling techniques are developed. User profiling models users' preferences [7].

In [2], the authors discuss that improved modeling of users and items are important extensions to current recommender systems. More closely we can capture, learn and mine users' preferences, more personalized and hence effective recommendations we can deliver. Profiling a user by her navigation patterns or browsing history is discussed in [9]. In [9], authors also discuss how recommending items based on user's implicit behavior and feedback results in better personalization.

Other user modeling techniques include modeling based on users' rating attributes of an item [4]. User profiling represented as an instance of domain ontology is discussed in [6]. Capturing users' preferences by ontology based descriptions result in better recommendations. Profiling based on concept hierarchy and item taxonomy descriptors is discussed in [8], it means users' preferences are captured on a concept level rather than an item level [8].

Adomavicius and Tuzhilin [1] propose *Recommendation Query Language (RQL)*, which can do better profiling by taking multiple dimensions into account. Value of additional information in enhancing the quality of recommendations is being acknowledged. In [5], Helocker and Konstan presented the value of additional information in recommender systems.

Other approaches to user profiling also include user-item rating matrix and keyword vectors [7]. User's tagging behavior is also used to profile a user [7, 10]. In [7], the authors have modeled users' preferences through selection agents and collection agents. Whereas collection agent shows current topic, selection agent shows single user's preferences [3].

Literature survey is an indicative of the utmost requirement to profile a user better. Since, recommender systems' inception and personalization evolution, researchers have bought up very interesting and novel ideas for user profiling to add some additional information for understanding a user. Our work is in line and towards the same goal to improve personalization and hence recommendations by profiling a user from a distinct and novel strategy.

4 Conclusions and Future Work

Collaborative filtering, probably the backbone of recommender system is based on finding preferences of highly similar users with the target user. This similarity is based on the ratings similarity of users on products bought in the past. Based on it, the target user is recommended item liked by her neighbors. This is known as user based collaborative filtering. When we employ user agent at client end and perform collaborative filtering this is called user based collaborative approach using user agent, similarly finding items which are neighbors of users' preferred items collected through user agent is called item based collaborative filtering using agent. In future, we will empirically test collaborative filtering using user agent and observe its performance improvement over traditional collaborative filtering approaches (user based collaborative filtering and item based collaborative filtering). Currently, we are in the process of building a prototype. So, in future we will be able to show the effectiveness of this approach empirically on recommendation results.

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