The Emotional Factor: An Innovative Approach to User Modelling for Recommender Systems

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Abstract. The ability to express and recognise emotions is a fundamental element of human social interaction. With regard to web services, user requirements can be forgotten and forsaken when the user's emotional needs are satisfied. The question, then, is how to improve recommender systems, and make them more pleasant to the user through the perception of his/her emotional states. In a first attempt to answer this problem, we introduce in this paper, an innovative approach to user modelling that captures affective features and the emotional dimension of humans. The model we have developed takes into account both a content approach (based on the information of an isolated user), and a collaborative approach (based on the information of a community of users).

Keywords: Recommender Systems, User Modelling , Emotions, Services.

1 Introduction

The ability to express and recognise emotions is a fundamental element of human social interaction. The importance of providing computer systems with these capacities is widely known in different research areas such as affective computation [1], emotional agents [2], computer animation and virtual environments. Researchers in all these areas are dealing with the problem of modelling emotions that represent approximations to user personality.

The study carried out by Rosalind Picard [3] showed that users transmit their requests together with emotions that can be assisted by emotional agents. With regard to the service, objective requirements can be forgotten and forsaken when emotional needs are satisfied.

The question, then, is how to improve recommender systems, and make them more pleasant to the user through the perception of his/her emotional states. How can we make a more effective and satisfactory interaction?

So far, these questions remain unanswered. Research in this area is only just beginning and further studies are needed to investigate user models that represent the

underlying personality of users. Models should be coherent and independent while reflecting the subsequent changes in the user.

In this paper we show the advances that we are making in this line in our group, Agents Research Lab, at the University of Girona. We introduce an approach to user modelling, based on affective features and on the emotional dimension of humans.

The paper is organised as follows: In section 2, the basic features of recommender systems are introduced and also how emotional factors influence system responses. In section 3, a new user model is explained which is an attempt to develop the emotional factor in recommender systems. In section 4, the utility of the model in virtual communities is outlined. Finally, we give some conclusions.

2 The Emotional Factor in Recommender Systems

Recommender systems have emerged as a result of the need to provide people with tools that facilitate their navigation in cyberspace as well as to get advice about the many services and products available on the Internet. Recommender systems make assessments of the user based on the interests and preferences of a single person or group of people [4]. In the former case, recommender systems follow a content-based approach to advise users according to knowledge of past recommendations. In the latter, a collaborative-based approach is used to recommend products based on a virtual community of users. No matter which approach is followed, recommender systems maintain a user model, which stores the objective features of the products the user has previously shown interest in, as well as subjective features regarding the evaluation of such products.

Recommender systems are conceived as adaptive systems to accommodate the different functional and interaction facets of their different users [5]. It is important to distinguish between the concepts of adaptability and adaptivity. For our purposes, adaptability is the possibility of allowing the user to set up and modify system parameters to fit the system to his/her behaviour. On the other hand, adaptivity is the capacity of the system to automatically adjust such parameters to the user, based on a combination of knowledge and several hypotheses.

Bearing in mind the above definitions, our work is based on creating an adaptive user model that captures the evolution of the user regarding his/her mood. Emotional Intelligence has been described as an important part of human decision making [6]. It has been proved that, at a neurological level, emotions play a definitive role in the cognitive process [7]. From our point of view, then, a user model based on a set of objective and subjective characteristics, quantitatively and qualitatively measurable, is not enough to build systems aimed at supporting human decision making. In addition to these features, recommender systems should also be able to capture the emotional factor of the human being. The emotional factor is a subjective component as well, and to distinguish it from previous subjective approaches, we have called it the second dimension. We are trying to enrich user models through this dimension.

Providing user models with techniques deriving from studies on Emotional Intelligence, traditional recommender systems can take advantages of results in other areas such as Human-Computer-Interaction, which have started to incorporate emotions [8]. Thus, if user requirements regarding a product or service are satisfied, he/she will probably use the system again. Moreover, if the answer is complemented with the experience of having had affective dealings with the provider of the service, the degree of satisfaction and confidence felt by the user is greater, which in turn increases the probabilities of further use of the system.

Example

We use a restaurant recommender system to illustrate our approach. The user asks the system to recommend an establishment that provides the service that fits his/her requirements. We consider three cases:

> Case 1: when the recommender system bases its decisions on objective features of restaurants.
> Case 2: when recommendations are based on objective as well as subjective features.
> Case 3: when the emotional factor of the user is taken into account in the decision process.

Let's assume that the user asks the system for a certain service with the features he/she requires (objective). The system then provides the user with a list of the three most interesting services according to those requirements, from the set of available restaurants shown in table 1.

Table 1. Set of available restaurants.

Name	City	Cuisine	Price
Cal Ros	Girona	Catalan traditional	€€
Mas Xirgu	Girona	Barbecued Beef	€€€
La churraskista	Girona	Argentinian	€€
Albareda	Girona	Traditional	€
Japón Tokio	Girona	Exotic	€€
Maria	Girona	Traditional	€
El Pati Verd	Girona	Bite to eat	€

Case 1.
The objective features, always pertaining to the restaurants, are: the city where the restaurant is located, the cuisine offered by the restaurant, and the price of the menu detailed in rank order. Let us suppose that the user makes the following request:

> City: Girona
> Cuisine: Traditional
> Price: Economical (€)

A recommender system which considers only this objective information will provide the following results (in order of interest to the user):

> 1) Maria

2) Albareda
3) Cal Ros

You can see that the restaurants recommended are those that best comply with the specifications provided by the user.

Case 2

In the second case, the recommender system considers subjective features, which we assume have been already captured on the user profile by one of various methods, such as, for example, the ones described in [9], [10] or [11]. Suppose we have available the following subjective issues: quality of food, amount of food and type of environment (cosy, normal, day-to-day). In order to find restaurants satisfying such demand, the recommender system needs to know the information shown in table 2. How to obtain this information is outside the scope of this paper; but several previous systems have developed methods to incorporate it into virtual communities (see again [11] for example). In particular, we suppose that, within the virtual community in which the user interacts, there is an evaluation of the restaurants available (table 2). In addition, from user's interaction with the system, the recommender system has saved the following preferences in the user profile: good quality, a cosy atmosphere and an abundant meal, in that order of importance.

Table 2. Subjective features of restaurants.

Name	Quality	Quantity	Environment
Maria	Bad	Scarce	Day-to-day
Albareda	Good	Normal	Cosy
Cal Ros	Regular	Normal	Cosy
El Pati Verd	Good	Normal	Cosy

Now, the recommendation of the system is based on:
- objective features, so it could include restaurants from the previous list of recommendations (case 1). It is also based on:
- subjective features, which may result in the exclusion of some restaurants and the inclusion of new ones in the list of recommendations that might meet subjective requirements, but not objective ones.

In the example we are dealing with, the system outcomes are:
1) Albareda
2) Cal Ros
3) El Pati Verd

Notice that a new restaurant has appeared (El Pati Verd) while another one is no longer recommended (Maria). The reasons are evident when you look at the information on the restaurants: the Restaurant Maria does not satisfy the subjective characteristics of the user to the same degree as El Pati Verd does. Since subjective features are more important than objective ones, the system has decided not to recommend the restaurant Maria but El Pati Verd. The latter, even though it does not

satisfy all the objective features (type of cuisine is not satisfied), does fit the subjective characteristics to a greater degree.

Case 3
In the third and last case, the recommender system takes into account attributes related to emotions, such as:

- familiarity (confidence) in customer's relationships,
- degree of patience that the user has when waiting to be served,
- the efficiency the user needs to feel around him/her, and
- the curiosity he/she feels for "exotic" restaurants.

How to obtain these characteristics is explained in the following section. For the sake of simplicity in our example, let's suppose that we have in the user model the different degrees at which the user is sensitive to the above mentioned emotional features:

> Familiarity: 70 %
> Patience: 20 %
> Efficiency: 85 %
> Curiosity: 50 %.

We can see, then, that the user is particularly sensible to efficiency, as well as to a familiar relationship. Also, curiosity scores quite highly, indicating a willingness to explore new environments.

Let's suppose that the mapping between services and emotional features is the one shown in table 3 (the procedure to obtain this mapping is explained in the next section). Now, the list of recommended restaurants suggested by the system is as follows:

> 1) Mas Xirgu
> 2) Cal Ros
> 3) El Pati Verd

Again, a new restaurant appears in the results: Mas Xirgu. The reason for recommending Mas Xirgu lies in the fact that it has been evaluated as highly efficient, (efficiency being the most important emotional feature according to the user's profile). Moreover, the degree of familiarity with which the user will be served is the expected one.

Table 3. Mapping between emotional features and restaurants.

Name	Familiarity	Patience	Efficiency	Curiosity
Albareda	20%	50%	30%	100%
Cal Ros	50%	50%	30%	100%
El Pati Verd	20%	50%	70%	100%
Mas Xirgu	100%	100%	100%	80%

The user may follow the recommendation of the system and go to Mas Xirgu, forgetting the specifications that he has initially formulated (based on objective features), and may even pay more than three times his/her original expectation, due to the fact that the recommended restaurant satisfies his emotions. This situation constitutes a common pattern of how, every day, people use their emotional intelligence more than their rational intelligence in decision making.

3 A User Model Based on the Emotional Intelligence

There are a huge number of parameters with which emotional intelligence can be measured, ranging from feelings of boredom to feelings of happiness and euphoria, from hostility to fondness, etc. All of them should be taken into account when building a user profile. As a starting point, however, and bearing in mind the application on which finally we will test our system, we have considered only seven attributes: love, fondness, impatience, desperation, confidence, depression, and curiosity. We obtain them by providing the user with some tests based on experiments carried out on emotional intelligence [12]. These tests are designed to obtain parameters of sensitivity, which determine the user's emotional profiles (Fig. 1.).
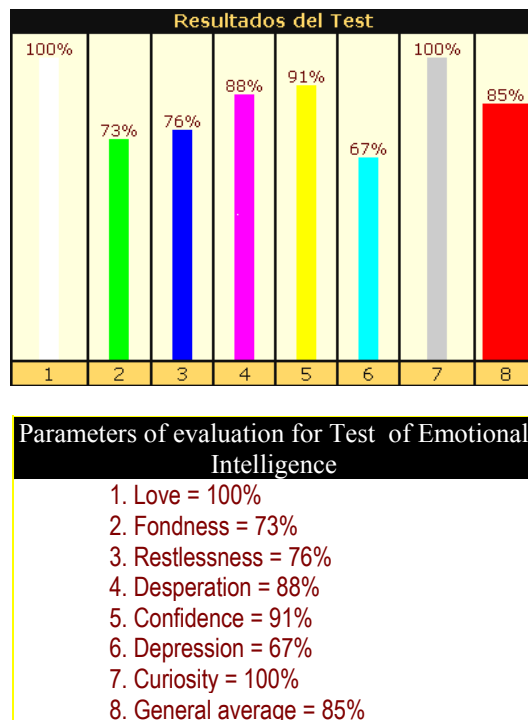

Fig. 1. Result of a test of emotional intelligence.

Once we have the users' emotional features, we need to make them correspond to the web services that a recommender system recommends. In this respect it is necessary to establish a mechanism to map the emotional features to measurable service features. That is to say, to make the emotional features operational in a domain. This is a complex problem that has already been addressed in the field of avatars [13]. Using a similar approach in our model, the mapping depends on the context. For example, in the restaurants domain, the mapping between emotional features and restaurant services is established as follows:

Familiarity = f (number of tables)
Patience = f (average time to serve the first dish)
Efficiency = f (professional staff, years opened)
Curiosity = f (cuisine, environment)

Particularly, for the restaurants shown in table 3, the following values have been computed (table 4):

Table 4. Information on restaurants.

Name	Number of tables	Time to serve first dish	Professional Employees	Years opened	Cuisine	Environ- ment
Albareda	>20	25'	No	<5	Traditional	Cosy
Cal Ros	10-15	25'	No	<5	Traditional	Cosy
El Pati Verd	>20	30'	No	10-15	Bite to eat	Cosy
Mas Xirgu	<10	10'	Sí	>15	Barbecued beef	Cosy

The procedure explained for computing the emotional values can be seen as a special case of the methodology for recommender systems based on product content [14]. This methodology is based on measurable parameters of services utilised by the user in the past. A single user profile is enough to perform recommendations which are based on the history and evaluation of the user. Remember, however, that the user profile we are proposing is extended to include emotional features and therefore the results will obviously not be the same. Another way of obtaining emotional values for services is by means of similar emotional profiles within a virtual community.

4 Application of the User Model to Virtual Communities.

In the future, the processes of recommendation within virtual communities will involve the interactions among people who share a high degree of emotional affinity, instead of interactions based exclusively on common interests. As happens in real communities, the strongest and longest lasting interactions will be created according to similarities among the personality traits of the individuals who shape the community. The definition given by [15], which has changed the paradigm of virtual communities, emphasises the fact that a group of people need to hold conversations

for sufficient periods of time and with sufficient human feelings in order to form networks of personal relations on the Internet, before a virtual community is born. Likewise, strong emotional links are described as a fundamental attribute in shaping virtual communities in [16].

Currently, recommender systems are centred on the interaction of the users with the content offered by virtual communities: information, products and services. Objective features (such as cuisine, price, etc.) are used to generate new recommendations to the user. Other approaches contemplate the use of certain subjective characteristics (such as quality) to provide recommendations based on similarities with other users [14]. The concept of virtual community lies in the fact that recommendations are based on similarities among users (collaborative-based techniques).

A complementary approach, and one which is closer to the definition provided by Rheingold, is when recommender systems centre their decisions on the user's emotional features. The system captures the varying emotions of users and interacts with the virtual community. When adding the emotional factor to user profiles, and adapting the user model according to alterations in user emotions over time, recommendations will be more effective from the point of view of satisfaction, and more opportunistic in terms of the moment in which the recommender system provides them.

In this respect, recommendations based on user communities represent a significant advance, since the similarity among users acquires the second dimension of the site utility: the emotional factor. This factor will attract users to a virtual community and will be closely linked to the emotional values that will encourage users to pay for the privilege of belonging to, and interacting with, that community. Then, we can speak about the emotional value of the community that is measurable in terms of the features of every member.

5 Conclusions

In this paper, we have introduced a new approach for modelling users of recommender systems based on emotional factors. Different attributes have been proposed to capture certain features of a user. By adding emotional features to the user profile, recommendations are improved in terms of the degree of acceptance from the user. The model proposed can be applied both in an isolated way (using content-based techniques) and within a community (collaborative-based techniques). Future experimentation with the model will tell us which one of these two approaches produces the best results; probably a hybrid of both.

The model proposed has been illustrated in the restaurant domain. Another context where the emotional factor turns out to be a key element is in team-work, such as, for example, in the design of chemical processes proposed in [17]. In this type of environment, the influence of the features of different individuals is a critical factor in the success of the project.

Finally, we would like to stress the correlation of our work to the research on context-sensitive agents [18]. The knowledge of the current situation of a user, combined with the knowledge of his/her user model can provide remarkable results in the field of recommenders systems.

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