A widget to recommend learning resources based on the learner affective state

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Abstract. This paper describes the Learning Resources Affective Recommender, a widget that recommends resources to the learner based on her current affective state and her learning objectives. The widget is meant to be used in a Personalized Learning Environment in combination with widgets to search for resources. The architecture that supports the widget follows a client-server pattern, with the widget as the client and a recommendation service on the server side. The paper includes the description of both client and server and a discussion about the possibilities of this approach.

Keywords: affective state recommender, recommendation widget, affective computing

1 Introduction

There is empirical evidence in the psychological literature that affective states affect cognitive processes like memorizing and decision making. This has provoked researches in the field of Technology-Enhanced Learning (TEL) to investigate the effects of including affective states into the design of technological tools for learning. Among the tools that take into account affective states we can find intelligent tutoring systems (ITS) [1, 2], narrative-centered environments [3] and environments to support reflection in professional learning scenarios [4].

However, there is a type of tools in the TEL field of TEL that still hasn't shown evidence of including affective states into its design process: recommender systems. As it has been reported by Manouselis et al. [5], there is a wide variety of approaches for the design of a TEL recommender system, but none of those presents an explicit application of the learner's affective state. Our hypothesis is that the resources provided by this type of applications will be more beneficial for the learner when her affective state takes part of the recommendation process. Thus, a frustrated learner might access a resource more suitable for her current state

Our proposal to explore the inclusion of affective states in recommender systems consists of a widget to be used in a Personalized Learning Environment

(PLE). The affective states are explicitly indicated by the learner, thus the detection of affective states is out of the objectives of the widget. The widget architecture follows a client-server approach, where the widget plays the role of the client and a web-based recommender service plays the role of the server. Besides the affective state, the widget also considers the learning objectives of the learner in the recommendation process.

The rest of the article is structured as follows. Section 2 describes the widget, its architecture and both of its components. Section 3 discusses the evaluation of the generated recommendations and future work.

2   Learning Resources Affective Recommender

The architecture supporting the Learning Resources Affective Recommender (LRAR) follows a client-server approach, where the widget and a recommender web service the role play the role of the client and server respectively.

2.1   Recommendation service

The recommendation process follows the method known as collective intelligence or collaborative filtering, and we have used the machine learning engine Apache Mahout for its implementation. Collaborative filtering can be item-based or user-based. When based on item similarity, a user is pointed to items that are related to the items already accessed by the user; a common example of this approach is the Amazon recommendation system. On the other hand, user-based collaborative filtering finds *neighbors*, users with similar patterns of resources accesses, and then points the user to resources relevant to her neighborhood. Henceforth, given our educational context we will refer to the users as learners and to the items as resources.

Our recommendation service is follows the user-based approach. The key element in the process is the similarity function that identifies the neighbors of a given learner. In our implementation, the similarity of two learners is proportional to the amount of resources accessed by the learners when indicating the same affective state. The proportion of common learning objectives also affects proportionally the similarity metric.

The recommendation service also handles secondary but needed functionalities, such as the creation of a learner profile, the change of mood informed by the learner and the addition of a new learning resource. For this, it was needed to model four entities and their respective relationships: affective states, learners, learning objectives and resources. The creation, edition and elimination of these entities is available through a RESTful web API, using the JSON format.

2.2   Description of the widget

The widget has been developed on top of the ROLE Project [6], which aims to provide the learner with a framework to build her Personalized Learning

Environment. The widget has been developed with JavaScript and HTML, and it follows the OpenSocial Gadget specification.

Three different sections have been included in the widget: Resources, Profile, and Settings. Resources is the main tab and has to functions; first, it allows the learner to state her affective state from a static list provided by the recommendation service. Second, it provides a list of learning resources ordered by relevance for the learner in her current state.

The Profile tab presents a time-line of the affective states reported by the learner. Its objective is to provide the learner with a visualization of her emotional changes during the learning activity being performed. The log of affective states is also provided by the learning resource service.

Finally, the Settings tab allows the learner to set her learning objectives. These might be changed during the learning activity, which also triggers a change of the learning resources that are recommended. Fig. 1 presents a screen capture of the widget in action, with emphasis on the resources recommended to a frustrated learner.
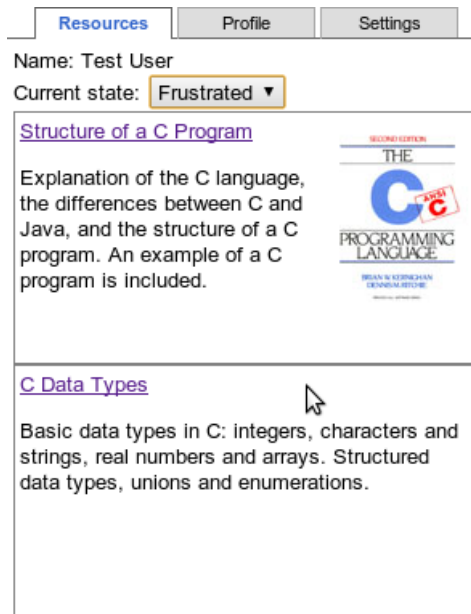

Fig. 1. Recommendations provided to a learner feeling frustrated.

3   Discussion

The Learning Resources Affective Recommender is our proposal to analyze the effect of including affective information into the logic of a TEL recommender system. This approach allows learners to obtain recommendations based not only on their learning interests but also on their changes of affective states during a learning activity.

Further work for LRAR is the evaluation of the recommendations generated, specially when compared with a system unaware of affective information. Our plan to perform this evaluation is through the comparison of metrics used in information retrieval, like precision and recall.

Another line of future work consists of the use of sensors as a complement to the affective state self-reported by the learner. We have special interest in sensors for galvanic skin response and for the recognition of face gestures. The inclusion of these sensors might provide affective states with higher accuracy and thus help to improve the recommendation process.

Acknowledgment

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