Affect Assessment in Educational System Using OutSite Factors

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Abstract. This research presents an approach to the improvement to the hedonic qualities of user performance in web interfaces based on the principles of emotional design. It addresses the issue of how emotional factors can be integrated into the communication between users and the web systems. The paper describes factors that can be used in emotion recognition for adaptation upon the user's emotions in online Intelligent Tutoring Systems. The integration of cognitive methods for web system design and computational techniques for the representation of emotional elements of users forms the core of the system architecture in which aesthetics and emotions are combined in computational terms for supporting users in a more emotional way.

Introduction

To date researchers have tried to create intelligent computers considering human cognition, reasoning, learning, perception, and language. Cognitive Science considers that emotion plays an essential role in human intelligence and behavior, and this indicates the need to rethink the role of emotion in building intelligence in computers [13]. Gratch and Marsella [7] believe that emotions are an essential part of human live and impact on their beliefs, inform decision-making and in large measure provide guidance on how to adapt their behaviour to the world around. Managing the effective communication between human and computer is a major task for interface designers as it is considered that memory is related to emotions [2]. As emotion is essential for human cognition and memory [13], many of the studies of emotions in computers are addressing the problem of how to improve the student's performance in Intelligent Tutoring Systems (ITS) using affective computing techniques. The concepts of Emotionally Intelligent Tutoring System (EITS) which uses emotions to improve learning efficiency were described by Ochs and Frasson [11]. Burleson and Picard [3] have purposed an affective companion that is keeping the user to have optimal experiences and sustain their motivation during studding. Benchetrit and Frasson [1]: purposed an idea for an agent that is based on the teaching method of the Bulgarian doctor and psychotherapist Lozanov [10], however the method of the doctor is not confirmed itself and has not been practiced widely.

In this work, we present a model of emotional factors for adaptation of web tutoring interface upon the user's affect. The model has the goal of establishing the standards for hedonic web interfaces that can tackle the affective state of the users. The purpose of the implementation is to provide emotional and usability support of the user with hedonic qualities, as we expect that the user performance will increase due to the emotional features of the system.

It is a complex task to "introduce" emotions to computers. In order to achieve the tasks of emotional tutoring interface several major issues are involved:

- Obtaining affective information about the user: make the system appropriately assume the affective state of the learner;
- Make reaction to the assumed affective state.

Many kinds of knowledge are involved in order to achieve the accurate results such as Pedagogy, Human-Computer Interaction, User Modeling, Psychology, and so on. Our approach is multidisciplinary based on the design research, practice and principles.

1. Affect Assessment Approach

1.1 Basic Emotions

Emotion recognition is a complex task and requires deep understanding of different knowledge fields. In an attempt to reengineer the state of online tutoring systems it is essential to look first at existing pedagogy approaches. Gathering knowledge from observation of experienced teachers can help implement emotions in the computer teaching systems. Computer system lack the ability to make individual approach to gather emotional knowledge about students while supporting teaching expertise and subject domain needed. There are a few major questions in making a belief about emotions in web based tutoring system: Which are the basic emotions involved in positive studying as the number of emotions can be large? What are the factors of these emotions in order to detect them? How can we make a computer detect those factors?

In the learning process memorization is done by associating emotions to the material. It is well known that the positive emotions are involved in the constructive learning process [9]. The positive emotions also increase the motivation and the learner is more focused on the material [8]. The goals of the EITS are to soften negative emotions to positive ones, and preserve the learner positive experiences in order to facilitate the constructive learning process. The motivation have been important for ITS as well, Vicente and Pain [16] are assigning to the motivation in ITS the variables: control, challenge, independence, fantasy, confidence, sensory interest, cognitive interest, effort, and satisfaction.

The number of possible expressed emotional elements involved in a web interface can be huge, with many variations. We have focused on the basic emotions. Many psychologists have tried to define the basic list of emotions. One of the well known definitions is the one of Plutchik [14], i.e., acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise and all the other emotions are mixtures, or compounds of the primary emotions. The cognitive theory of emotion developed by Ortony Clore and Collins [12] defines emotions as valenced (positive or negative) reactions to situations consisting of events, actors and objects. Further more, the valance of the emotion occurred depends on the desirability of the situation and one's goals and preferences. Rosalind Picard, Barry Kort and Rob Reilly have purposed emotion sets involved in the un-learning and constructive learning processes: anxiety-confidence, boredom-fascination, frustration-euphoria, dispirited-encouraged, terror-enchantment [9]. Based on the theories above we are making assumption about the possible emotions involved in the interacting process with web based tutoring system, which shall be evaluated further, see Table 1.

Table 1. Basic emotions that we assume occur during interaction with educational system

Negative	**Positive**
Distress	Joy
Fear	Confidence
Boredom	Fascination
Unsatisfied	Satisfied

1.2 Affect Assessment Approach by Reasoning the OutSite Factors

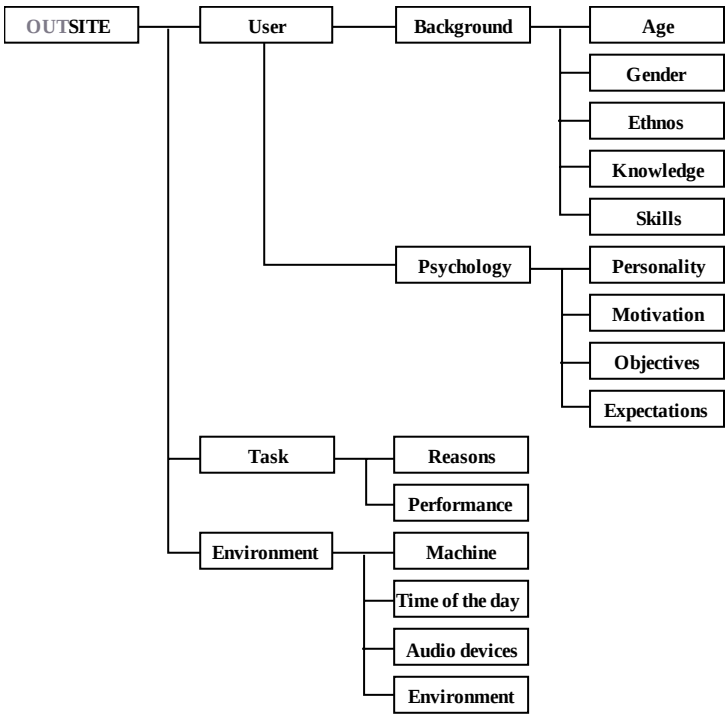
To make the computer recognize emotions, many researchers are focusing on affective wearables: physical devices that users wear with, and the computer is used to read their emotional parameters. The computer might recognize emotions as well by interacting with different agents. The human model is based on the assumption that people do not necessarily recognize emotions just by signals seen or heard, they also use a high level of knowledge and reason about their goals, situations, and preferences. It is predictable the person's emotions if their goals and perception of relevant events are known [12]. Implemented in a computational model this can be achieved by using agents, artificial intelligence techniques reasoning on goals, situations, and preferences [5], [4]. For example, if the system can reason about the reactions of a user from the input that the system receives, (assumption made based on the time of the day, speed of reading, browsing path and so on) appropriate content will be provided and displayed in a way adapted for the emotion or the mood of the user. Negative or disturbing emotions should be softened to stimulate the positive ones, the users are less effective at learning when distracted, bored, and stressed or feeling extremely excited. For the system adaptation we have chosen to use basic emotional features, which we consider reasonably sufficient and accurate for an experimental study.

To represent to the computer the emotional signs - the emotion factors that are involved in the interaction with educational tutoring system need to be collected. We have tried to collect Human–Computer Interaction (HCI) factors, outside the system (OutSite factors – which we use short from 'outside the web site'), that are related to the user, task and environment, which also have impact on the user's emotions. The recognition of emotions will be done using a reasoning system which takes the OutSite factors as the input, i.e., the input and assumptions regarding the goals, situations, and preferences of the user.

In the diagram of the OutSite factors (Fig. 1) are presented the factors that we collected and we believe that might have relations with the user's emotions when interacting with a web based system. They are classified in a tree structure with tree major branches: factors related to *the user*, *the task* that has to be accomplished by visiting the web site, and *the environment*. In the diagram the user related factors are mainly about their backgrounds and psychological profiles. *The background* involves the age, gender, ethnos, knowledge and skills of the user. *The gender* and *the ethnos* can have impact on a person's emotions according the Hofstede theory of masculinity and femininity [6]; *the age* has relation to the subject preferences of the students. *The personality type* (introvert or extrovert) has relation to their aesthetic preferences. For example extroverts prefer more attractive and dynamic interfaces and the opposite, i.e., the introverts, like more useful and less distracting interfaces [5]. The perception of colors in web sites is linked to one's emotions and personality [15]. The motivation is a subcategory of psychology, as in this section we combine the cognition elements involved in the process. The objectives are the personal reasons to attend the course, they have relation to emotion because the reasons can vary in valance: the student have been forced by the parents, the student like the course and want to enjoy it, the student has motivation to learn something new and so on.

The expectations can be used as a measurement tool of the happiness at the end of the course: a high expectation may cost disappointment.
The emotion recognition will be made by evaluation of the probability. The collection of information about the OutSite factors will be made by their input into the system only. The basic scenario is that the user in order to access the tutoring system will have to fill few questions to get a password. The questions will be related to age, and personal preferences. The other factors can be obtained by web programming such as location, task performance, and environment. Self report method will be more limited as we assume that it may take time for the student to report himself and also this may cost distraction. The system has own observations on how fast the pages are browsed respectively the student has get the materials and test results, and from this information can reason about the task performance. In the case when the user is browsing more slowly in time T+1, than they were clicking in time T, then a belief can be assigned in the system that they might be distracted, annoyed or less focused. As different emotions have priorities in humans [13], the same way the computer database also needs to have priorities that organize the importance and intense of the assumed situations. Such reasoning and judgment of the user's behavior is an intelligent way to tackle online adaptation upon visitor's emotions. Furthermore this simple model can mimic the human reasoning, by providing the system with knowledge about real satiations.

Figure 1. OutSite Factors that are related to the user's emotions in a branching hierarchy configuration



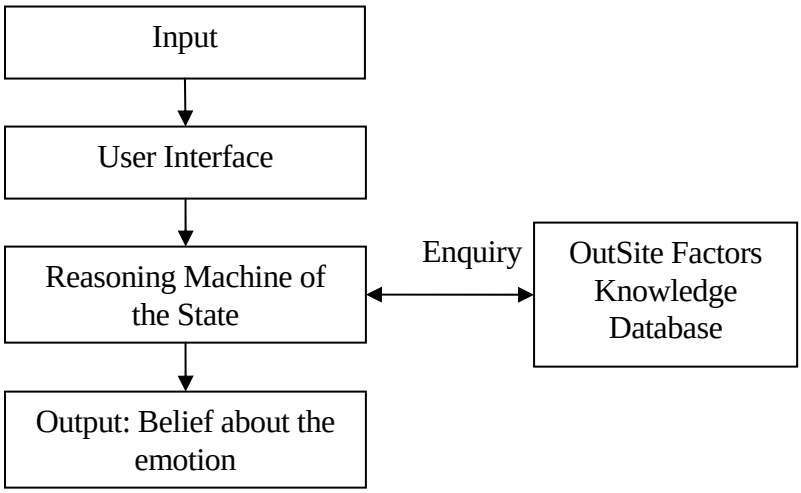
2. Related Work and Application Scenario

2.1 Application

In the previous section we have describe the factors that can be used to detect the affect. Here we are purposing a simple system configuration of how the OutSite factors shall take place into EITS (Fig 2.). A multiple input will be taken to get various responses from users. The occurred situation is to be analyzed by the reasoning system. When OutSite factors are determined, an

InSite element or elements have to be composed for the system to respond to that emotional belief of the user in an appropriate way. For example the user is self reporting that they has high motivation to accomplish the course. This input is passed to the reasoning machine, that reference the OutSite knowledge database about the priority of this factor and the description of it and the emotions attached to this factor. Based on that information the reasoning machine can make a belief about the emotional state of the user. Some previous state might have been reordered in the system, for example earlier at time T.

Figure 2. Adaptation Process

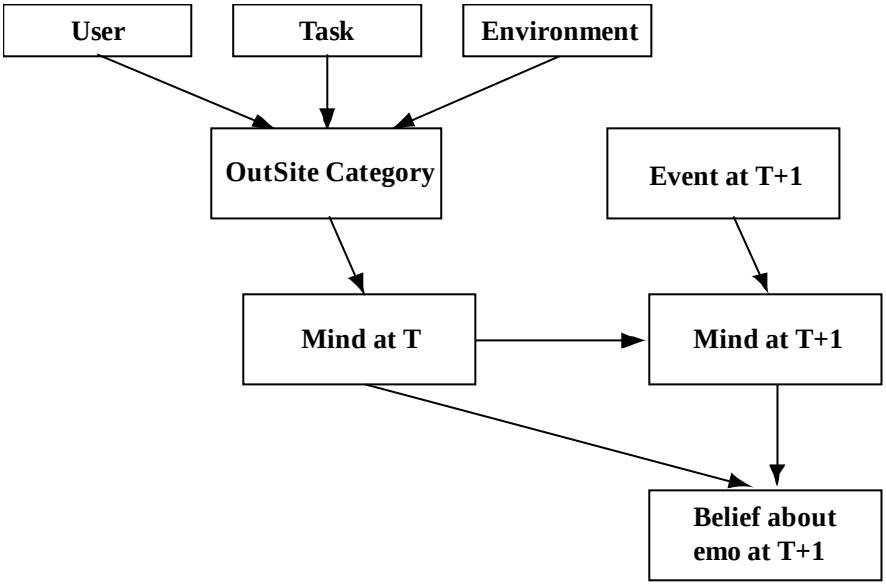


The problems of implementation of those factors are that 1) It is difficult to predict the initial emotion of the student, that they might have already set to a certain mood due to other outside factors related to their private life; 2) The emotion factors are having different weights: the possibility that some factor may influence the emotions. 3) The purity of emotions: the case when the emotions overlap [13].

2.2 Related Work

Carofiglio, de Rosis and Grassano observed the problem of overlaped emotions [4]. A computational model for making an artificial triggering of emotions over time and represent to an educational agent was made by using Dynamic Belief Networks (DBSs). Events occurred during a time interval (T,T+1) are observed to make a belief of the new state and reason about emotions that might be triggered by these events. The calculation of the intensity of emotions made by the uncertainty in the agent's beliefs about the emotional state and the weight assigned to this emotion. The variation of intensity in the emotion is assigned by the probability that certain factor will take place, times the weight of this factor (Fig. 3).

Figure. 3. Monitoring of Emotional Belief based on Carofiglio, de Rosis and Grassano



3. Future Work

We have taken a symbolic approach to improve the usability of web interface by adding an emotional response system to a web interface design based on a simple list of emotional elements. The OutSite factors have to be implemented in tutoring system using decision making approach. The future work is the InSite factors to be determined and adapted upon the belief of the student's emotions. While the system can not change the OutSite factors, it has a full control on the InSite factors. This approach is to be evaluated with interface and graphical designers when the system is fully implemented with an intelligent web based tutoring system as an example. We will find out whether the model is accurate for measuring the improvement on the study abilities of the students. The evaluation will be made by usability and design methods such as semantic differentiation. This approach has been used by designers to measure the experiences of new products.

Acknowledgments

This research aims at adding a new dimension to the existing research projects in the Design Technology Research Centre in the School of Design of the Hong Kong Polytechnic University, which are still largely based on digital and computational models, whose inference control mechanisms are not based on human cognition, rather, they are based on symbolic models of mathematic and mechanic thinking. This research is supported by a PhD studentship from the Hong Kong Polytechnic University.

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