Abstract
This paper presents results of a master thesis at the Fraunhofer Institute for Computer Graphics Rostock (IGD-R) at the department for Human-Centered Interaction. Using an emotion recognition sensor system, an e-learning system was enhanced with affective abilities. By taking certain actions, the user is supported to handle negative emotions, which should enable a better learning as well as a greater satisfaction. The affective communication and actions are encapsulated by an Affective Component, which was implemented as a prototype and evaluated at a first glance.

Keywords: HCI, Affective Computing, E-Learning

1 Introduction
Despite the ongoing development in technology over the past decades, computers still do not consider emotions of their users, even though many studies (e.g. Reeves & Nass 1996) showed how important they are for human-computer interaction. With the focus on innovative and user centred interaction technologies, the interplay between emotions and computers, widely known as affective computing (Picard 1997), plays an important role at the department for Human-Centered Interaction.

Traditional e-learning systems focus on the learning target only, whereas human expert tutors also concentrate on the emotional component of learning (Lepper & Chabay 1988). This seems to be a good model for e-learning, as negative emotions like boredom or anger reduce cognitive effort and in consequence hinder the achievement of learning goals.

2 Emotion detection
Emotion detection represents the first step in building affective applications. One way of detecting emotions is to analyse physiological data to deduce emotional states. The emotion recognition sensor system (EREC), developed at the IGD-R, consists of a sensor glove, a chest belt and a data collection unit (Figure 1).

Integrated in the glove are sensors for e.g. skin resistance and skin conductivity. Evaluated and enhanced sensor data are wirelessly transmitted and made available to a PC (Peter et. al. 2005). EREC is used for emotion detection by the Affective Component.

Figure 1: Emotion Recognition Sensor System (EREC)

3 Negative emotions and target emotions
The Affective Component is based on Russell's circumplex model of emotions (Russell 1980), a dimensional approach for classifying emotions. It assumes the existence of the dimensions valence and arousal utilized to describe different emotions. Instead of single emotions, only regions of the valence-arousal-space were taken into account. Thus, a concrete classification of emotions could be avoided.

Figure 2: Russell’s circumplex model with regions
For learning, two negative regions in the valence-arousal-space can be defined that should be avoided. By negative valence and positive arousal region I is described, which stands for emotions like frustration and anger. Emotions like boredom and sleepiness are represented by region II, located in an emotion-space
characterized by negative valence and negative arousal. The target emotional region, specified by a slight positive valence and neutral arousal, provides a maximum of efficiency and productivity in learning (Kaiser 2006). Besides, the user will feel more comfortable during the learning process.

4 Affective measures and procedure

A catalogue of affective measures describes actions to support the user in handling negative emotions. Besides a distinction of measures for both regions, measures are application-independent or application-dependent. Examples for application-independent measures used by the Affective Component are motivational statements, the possibility to express displeasure, the suggestion of short break or even a way to treat the computer with hammer, flamethrower and chain saw to reduce stress (Figure 3).

Application-dependent measures, bound to the given e-learning system or at least to the application domain, are a change of lesson, another way of presenting the subject (e.g. an animation instead of pure text) or the start of a questionnaire to check the learners learn progress.

With a technology for detecting different emotions and well-defined regions of negative and target emotions, it is still open what the affective procedure looks like. If negative emotions from one region are dominating for a certain time, an affective measure depending on the region is selected and suggested. If the user accepts, the chosen action is executed. Hopefully, his emotional state will be improved thereafter. For the pilot study, an intermediate step was needed. The correct detection of emotions was verified by asking the user, to ensure the initiation of a correct measure. However, it might be better to leave this out for final application.

![Figure 3: Measure to relieve stress and aggression (StressRelief 2006)](image)

5 Pilot study and preliminary results

The implemented Affective Component was tested with a pilot study. SmartBLU (SmartBLU 2006), a learning management system, was used as underlying e-learning system. Three questions should be clarified. Are users more pleased when using the affective version of smartBLU? Is a greater success in learning achievable? Do users of the affective version of smartBLU stay less at region I and region II and stay longer at the target emotional region? The first two questions were proofed by using questionnaires regarding satisfaction and factual knowledge respectively. Question three was checked by implementing the Affective Monitor, which logs the residence time at the different regions, the emotional states and the status of the Affective Component.

First findings show a tendency towards the expected results. Especially the success in learning of the affective testing group was slightly better than of the control group. However, results regarding the other questions were ambiguous. Possible causes may be measuring inaccuracies, the limited test duration and finally the limited number of test participants.

6 Conclusion and future work

The presented approach should only be considered as a first attempt of building an Affective Component making an e-learning system affective. Next steps are intended for further improvement. The selection of a certain measure, done coincidentally at the moment, could be based on information about the user. An affective user model is needed, which allows to arrange the single measures according to priority.

Furthermore, the affective procedure needs to be adapted individually. Based on experiences with the user, the moment of the initiation of measures, the minimum time between different measures or even the possibility to suggest an alternative measure in case of a rejection by the user could be defined more precisely. Finally, more extensive studies are needed for a final evaluation.

7 References


