Mobile Stress Treatment

The Interstress Approach

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Abstract—**This paper describes a stress treatment platform developed as part of the Interstress project. The platform includes multimodal mobile sensing which serves as an input to guide interactive relaxation exercises. The prototype application is described along with its main functionality.**

Keywords-component; formatting; style; styling; insert (key words)

I. INTRODUCTION

Stress is caused by different factors and can be a drive to get things done and meet deadlines. However, long-term chronic stress increases risk of other diseases such as depression, heart diseases and other health related problems. This long-term, psychological stress is difficult to treat, since it involves personal and social factors. In addition, the patient might not be aware of their stressed condition, leading to difficulties in addressing the problem. Therefore, the use of monitoring technology is investigated as a factor that can lead to awareness of psychological stress and means to treat it.

The INTERSTERSS project (www.interstress.eu) targets two scenarios, related to clinical and mobile settings, however this paper focuses on the mobile scenario. The objectives of the mobile platform running on the patient's smartphone are two-fold. Firstly, it monitors patient state and context using multiple sensing modalities (such as accelerometers, heart- and respiratory-rate sensor, location, social interactions). By leveraging this objective information, the therapist can gain a better insight into the patient's issues and provide more efficient personalized treatment. Secondly, the mobile application helps the patient by providing interactive counter-stress exercises, as well as tracking the progress of the treatment. The rest of the paper will detail the platform built and the mobile application.

II. PLATFORM OVERVIEW

The mobile Interstress system is split in two main parts: the mobile platform and the server-side component; the parts periodically synchronize with each other over a mobile Internet connection. A mobile device represents the mobile platform with a variety of on-board and external sensors. The external (wearable) sensor provides information about physiological state of the user, such as his/her heart rate, breath rate, motion activity. This information is then combined with the data from on-board sensors and the multimodal sensory information is then processed by the behavioral parameters module (BPM). The BPM extracts high-level context information from raw sensor data, such as activity level (static, walking, running), location (home, work), number of placed and received phone calls and messages. The collected information is then stored in the mobile device's local memory. This approach allows the mobile platform to remain fully functional without always-present internet connection: the data can be sent to the server when the connection becomes available.

At the server side, all the data is stored in the project's central repository. The sensory data is processed by a decision support system (DSS). The goal of the DSS is to assess the psychological state of the patient by analyzing the previous knowledge, such as patient's physiological and behavioral profile, and currently available sensory data. From that information, the DSS then infers physiological and behavioral markers of stress. In order to achieve this, the DSS employs knowledge-based models and machine learning algorithms. Once the information has been processed, stress level estimation is stored in the central repository. The therapist can then use the patient management system to analyze the data in order to identify situations that are stressful personally for the specific patient. The patient, in turn, can review his/her stress level history to confirm whether the therapy is efficient.

III. MOBILE APPLICATION

The application simultaneously performs two main tasks: data collection and stress treatment. Firstly, the mobile device collects psychophysiological state information about the patient during the day. These data are then used to train the decision support system, to monitor patient's stress level and to provide useful information to the therapist during clinical sessions. While being very important, this process requires little user attention and most of the time runs transparently in background. Stress treatment, in contrast, is well represented in the user interface by a number of functions (see Fig. 1), namely, relaxation and biofeedback exercises, stress history tracker and a list of "homework" assignments recommended by the therapist. In the following sections we describe these functions in detail.

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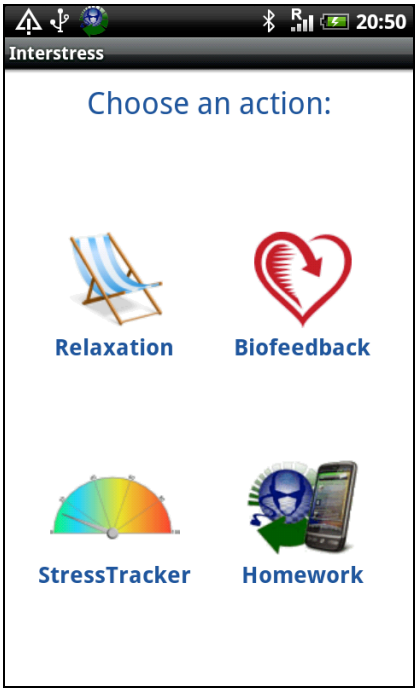

Figure 1. Application's main screen

A. *Relaxation*

This exercise allows the patient to relax by immersing into a calm and peaceful virtual reality environment. The walk through the environment can be accompanied either with soft music or a relaxing narrative designed by professional therapists. For better effect, the patient is free to choose between seven different environments, from beach or forest to campfire or mountain hiking (see Fig. 2).

Figure 2. Virtual reality relaxing environment

B. *Biofeedback*

The biofeedback exercise establishes a feedback loop between the user and the relaxation environment. In this exercise, the virtual scene reflects instant stress level of the patient: when the patient is tense, the scene looks gloomy or unsafe; as the patient relaxes, the scene gradually becomes more calm and peaceful. Thus, the biofeedback exercise trains the user to gain control over his/her stress.

C. *Stressometer and StressTracker*

Stressometer and StressTracker components provide the patient with graphic representations reflecting the treatment evolution. The Stressometer displays the current stress level of the patient, which can be either a recent accurate estimate acquired from the central decision support system, or a rough HRV-based approximation from the lightweight mobile DSS. Apart from the instantaneous values, the user can check the history of stress-level variations during the treatment period. This information is visualized by the StressTracker, which shows the number of detected stressful events over the course of last day, week, or month.

D. *Homework*

During the clinical sessions, the therapists may suggest the patient to perform a number of special relaxation exercises before the next session. The patient may easily access this "homework" via the appropriate button in the main screen of the application. Upon click, the application opens the patient's interface of the patient management system, and the user can review his/her assignments and check those which have been done. In the next clinical session, the therapist reviews the progress of the homework. By correlating exercise time with the stress level history the therapist can analyze which exercises were most effective against the stress and, if necessary, adjust the treatment accordingly.

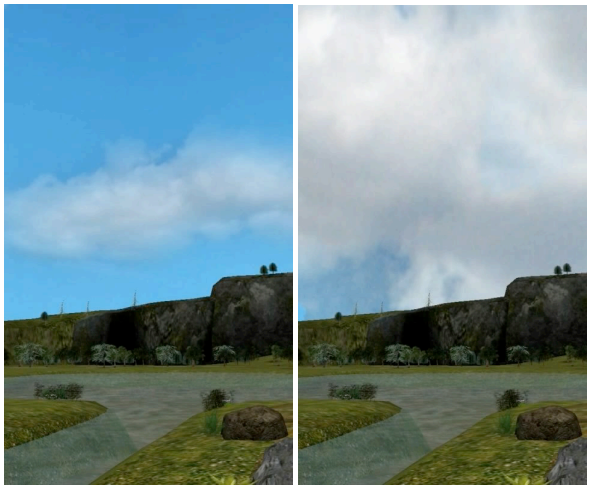

Figure 3. Biofeedback environment

IV. CONCLUSION

This paper presented a demo application dedicated to psychological stress treatment by means of information technology approaches, reinforced with multimodal mobile sensing, interactive relaxation exercises and machine learning methods. The paper also provided an overview of the created prototype application and its main functions. Currently, the development is complete, and the system is entering the phase of clinical trials.