Emotion sensing to improve quality of life of people with a mental disability

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People with a severe mental disability or dementia are often not capable of expressing their emotional feelings and therefore not able to indicate their care and social demand. This leaves these vulnerable people in many cases misunderstood and therefore not adequately treated and helped. The trust relation between the client and the caregiver is a core element in mental care. Better understanding of the emotions of people with communication restrictions will strengthen the trust relation between the client and the caregiver, and will improve the quality of life and happiness of these vulnerable people.

Mentech Innovation develops together with its strategic partner Severinus an emotion sensing and regulation platform to read to emotions of people with limited communication skills, like people with a mental disability or dementia. This solution will give people with mental disabilities a voice. The platform is based on the sensing of body parameters with wearables (EmoKit), the extraction of emotions via models and deep learning algorithms (EmoRadar), and methodologies for emotion regulation.

To investigate the possibilities for emotion sensing in people with intellectual disabilities, the collaboration with Severinus was started in 2016. First exploratory studies were carried out with an epilepsy detector to measure heart rate and acceleration. These studies conducted within Severinus show a clear correlation between increased heart rate and development of stress. For example in Figure 1, the heartrate of a client with severe mental disability is plotted during a morning ritual with breakfast, nurturing treatments and moments of relaxation. Through visual observations the state of mind of the client has been determined from a signaling plan used in daily care for adequate treatment in the encountered situation (neutral: client is calm, relax: client is feeling good, stress: client shows signs of tension). The figure shows a clear relationship between stress and increased heartrate. Stress arose especially during nurturing treatments.

These studies also showed that heartrate is not an unambiguous indication for stress build-up. Other factors also caused increased heart rate, such as swaying movements or walking to the toilet. Therefore, additional physiological parameters such as skin conductance and temperature are needed to get unambiguous correlations between physiology and stress development.

To this end, Mentech Innovation is currently developing a sensor system (EmoKit / EmoRadar) to obtain a better assessment of the emotional well-being of people with severe mental disability and communication limitations through non-visible physical characteristics. The first product is an exploration kit, based on a wearable for measurement of heartbeat, skin conductance, temperature and acceleration (smart watch EmoKit), and a tablet with software for data analysis and visualization (EmoRadar). This product is visualized in Figure 2.

To explore the capabilities of this exploration kit, a study into the physiological response to emotional content was executed. The exploration study was performed with a test group of persons exposed to a movie scene with stress/arousal-inducing content. The selected fragment induced emotional unbalance due to the transition from a scene with no stress (a young lady enters the free world after imprisonment, the observer may experience some tension though, because by the unexpected) to a scene with disgust (capturing and becoming a prey for cannibals).

The physiological response of the test group of 12 persons was captured with the Empatica E4 wristband. The measured heartbeat, temperature and skin conductance were fed into the developed arousal model, as given in Figure 3. This model was derived from literature results and results from the pilot study at Severinus. Arousal was identified based on pre-defined criteria for heartbeat, skin conductance and temperature set-points. The reference values were compared to moving averages, determined from the captured data.

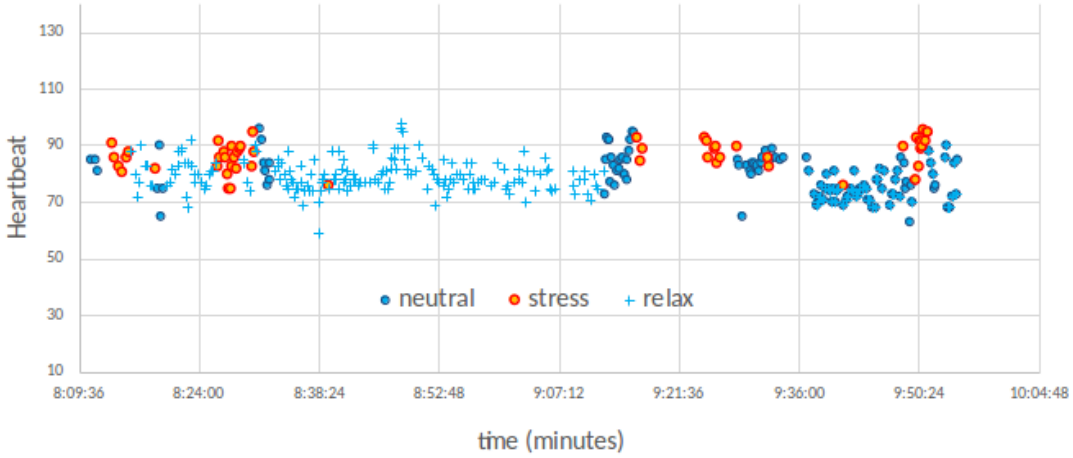
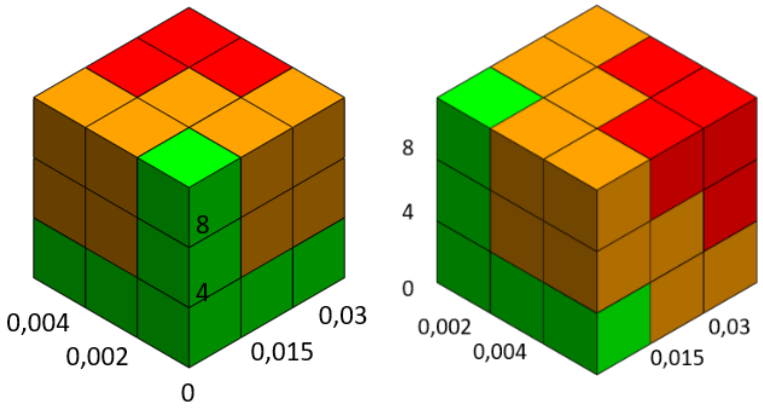


Figure 1: Heartbeat measurements of a client in a care house, exposed to stress-inducing activities (neutral: client is calm, relax: client is feeling good, stress: client shows signs of tension).

Figure 2: The Emokit/EmoRadar product to sense emotions developed by Mentech Innovation.



(a) (b)

Figure 3: Model to derive emotion signals from captured physiological data, green is no arousal, orange is mild arousal, red is severe arousal.

The EmoRadar platform from Mentech Innovation was used to analyze the captured physiology and to process arousal data. The results of this analysis are given in Figure 4. The heartbeat, skin temperature and skin conductance were processed via the developed model in Figure 3a to a normalized correlation function and in Figure 3b an arousal occurrence (mild arousal is indicated in the figure).

The blue lines correspond to the physiology measurements from the participants who declared that they did not experience stress from watching the movie fragment, the orange/red lines correspond to participants who indicated that they did experience stress. These measurements clearly indicate the difference in emotion patterns from these two groups of participants. The no-stress sensing participants had flat responses, the stress-sensing participants had strongly

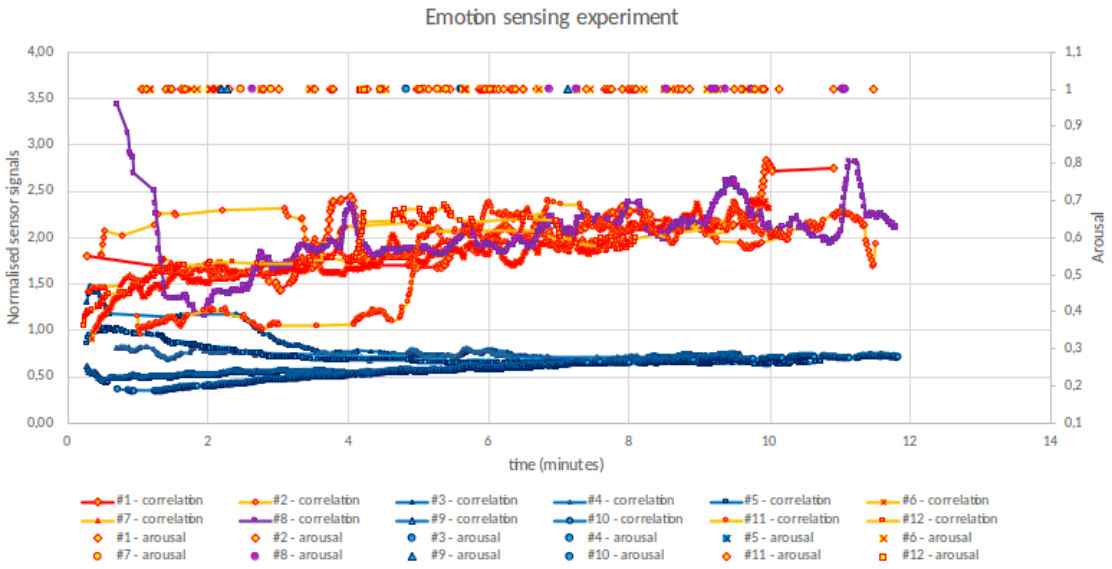


Figure 4: Emotion values based on the measured heartbeat, skin temperature and skin conductance for a test group of 12 persons exposed to stress-inducing video content.

fluctuating responses. The derived arousal events are plotted in the figure as well. It seems that the calm people experienced hardly arousal events, while the stressed participants had numerous onsets to arousal. As a next step, deep learning enriched analysis is conducted to further improve the sensitivity and resolving capability of the EmoKit system.

For further information:

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