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Intelligent emotions stabilization system using standarized images, breath sensor and biofeedback – preliminary findings - short communication

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Abstract

Purpose: Currently there is no direct method available to automatically distinguish between emotions by real-time computational analysis and stabilize emotional state of the subject using series of standarized pictures or others stimuli. The aim of this study was to find out whether is true if our new concept of intelligent emotions stabilization system can constitute another step toward better analysis and understanding of the aformantioned processess. The aim of this study was to compare normative ratings of the Nencki Affective Picutre System standardized images database with the emotional respiratory patterns.
Methods: The study group comprised of 150 healthy people (50% females; aged 20-26 years). Computational models of responses to the stimuli and reverse problem were created using the Matlab environment.
Results: The models were able to predict the levels of arousal, valence and self-emotional state in 90%.
Conclusions: Proposed approach can open a family of novel efficient methods for control of emotions by measure of breathing and appropriate sets of images (e.g. in affective computing applications).

Keywords: emotion, affective state, patent-therapist cooperation, computational analysis, artificial intelligence.

Introduction

Since early research by R. W. Picard concerning affective computing there is need for a new solutions of sensors and objective methods of cuch systems control, and objective classification and analysis of emotions. Current concept of the intelligent emotions stabilization system is as follows: our new SFM3000 sensor measures the emotion-related flow rate of air, sound of the pulse can play role of biofeedback, and standarized images can play role of specified stimulation controlled by the control system. Role of the control system, supported by our novel data analysis models and neural system models, is to tend toward required emotional state based on outputs from sensors, and individually shaped stimulation (images). Every image has validated features and influence – control system selects appropiate fo them. Each picture was earlier validated, identified by the NAPS arousal and valence scores, as well as by a self-reported emotional label (associating a subjective positive or negative emotion). The relationship between emotional feelings and respiration is surveyed and well known. Researchers use standardized images databases eliciting required emotional states, but these databases need validation using physiological features [1-4].

Aim of the study was to find out whether is true if our new concept of intelligent emotions stabilization system can constitute another step toward better analysis and understanding of the aformantioned processess. The aim of this study was to compare normative ratings of the Nencki Affective Picutre System - NAPS [5] standardized images database with the emotional respiratory patterns.

Methods

One hundred fifty healthy students (50% females; aged 20-26 years) participated in the study. Each subject was presented with 120 images of five categories (people, faces, animals, landscapes, objects) selected from NAPS standardized images database. The images were designed to elicit consecutively distinct affective states: neutral, positive, disgust, fear (from NAPS), sexual excitation (from other databases), each of them separated with mask. Our new SFM3000 sensor that measures the flow rate of air was applied to record subjects breathing. Models were created using the Matlab environment. To define the results of simulation various mathematical descriptions were compared and the best of them was optimized.

Afformentioned models required only information measured or easily achievable for every subject. Thus the models could be readily applicable in everyday clinical practice.

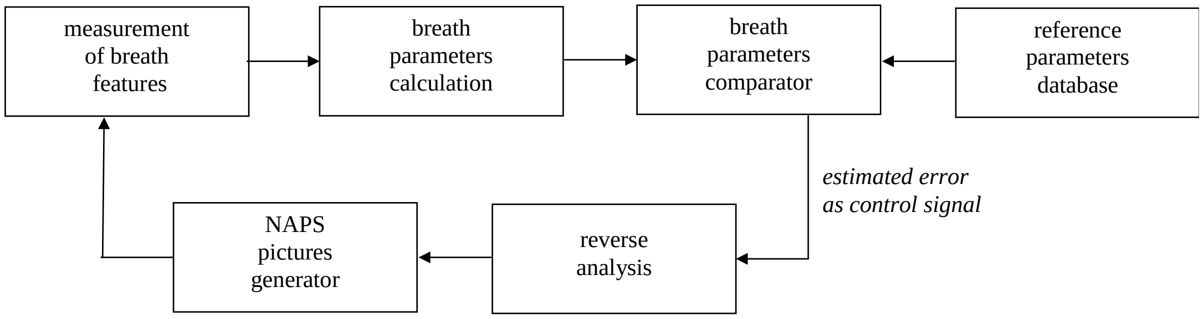

Figure 1. Basic concept of the dynamical breath simulator used in the research.

Results

Experimental results show a comprehensive emotional shaping of all subjects undergoing an affective interaction using a sequence of standardized images gathered from the Nencki's affective picture system (NAPS). Relatively simple solution may constitute next step toward emotion recognition and regulation based on physiological measurements. To provide proper system-human cooperation, the real-time classification of defined levels of arousal, valence and self-emotional state have to reach up to 90% recognition accuracy. Correlation between stimuli and breath features was detected. Main results of the study was establishing the correlation among amplitude, frequency, and selected features (valence, arousal, approach-acoidance) derived from effective images. This research helped us classify the breathing according to selected emotions characteristics. This results may be useful in reverse task, namely using breathing signals can estimate the emotional state.

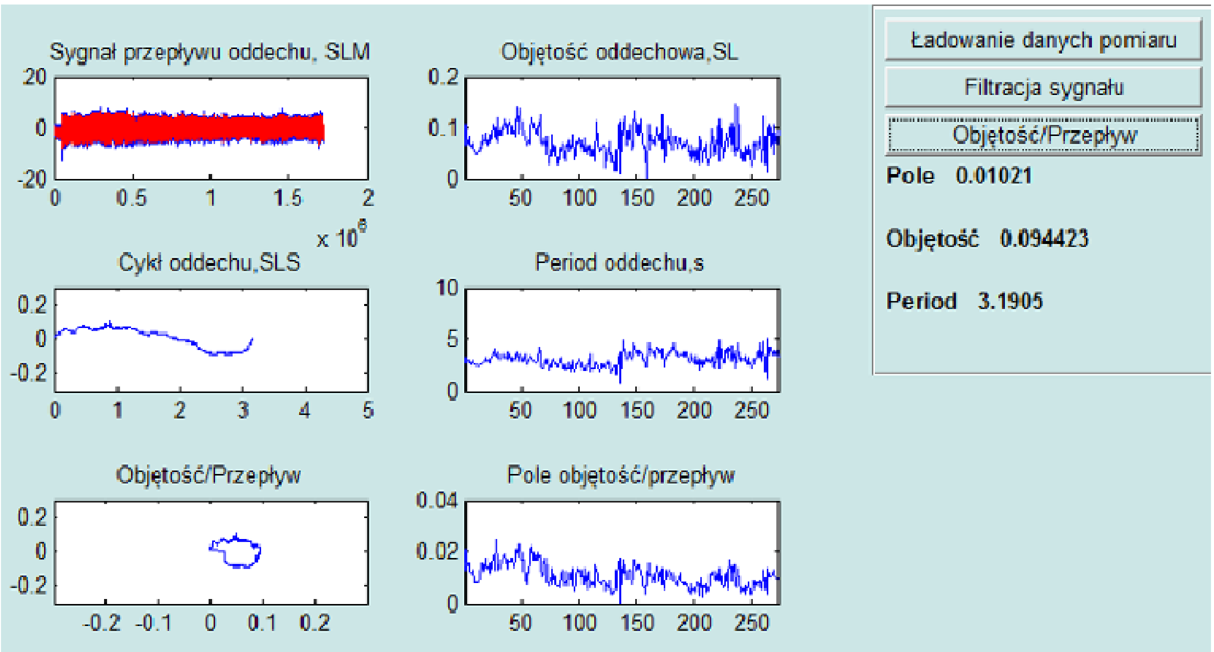

Figure 2. Sample results of breath features analysis.

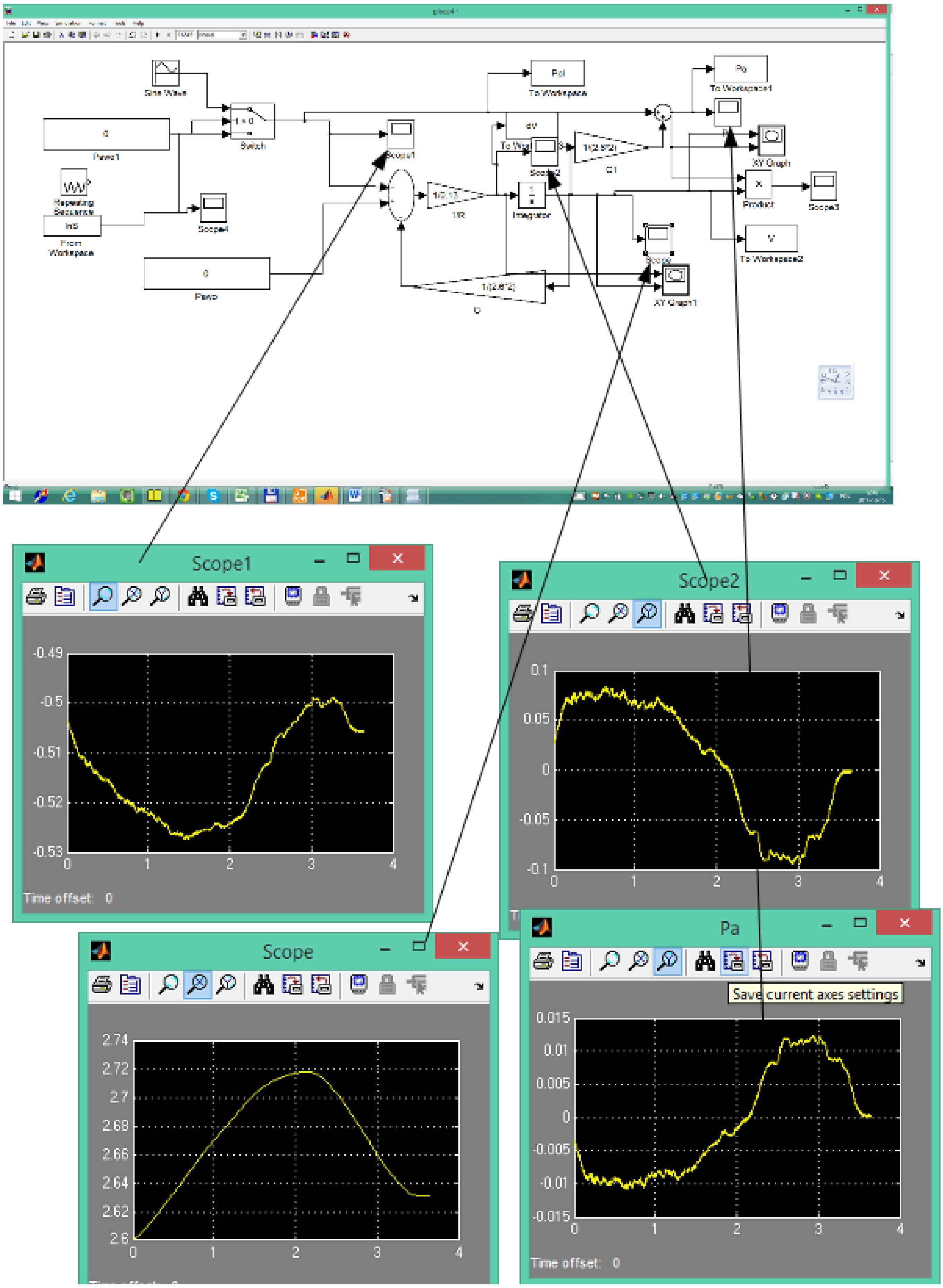

Figure 3. Sample results of reverse analysis.

Discussion

Currently there is no direct method available to automatically distinguish between emotions by real-time computational analysis and stabilize emotional state of the subject using series of standarized pictures or others stimuli [6, 7]. Proposed approach can be regarded as not integral part of biomedical research but can be easily translated into patient assessment, therapy and care, especially individualized (patient-tailored) [8].

Our studies concerning breath-based emotion recognition and stabilization are limited by:

- lack of previous similar solutions and concurrent approaches,
- need for very careful validation of breath response to stimuli (series of pictures from NAPS database),
- need for feature analysis and selection for real-time emotion classification puroposes based on own experiences and criteria,
- huge number of patients need for reliable and valid randomized controlled studies,
- necessity of further acjustment and optimization, probably depending also on target group.

Despite high recognition accuracy quality and error rate depend on mathematical representation of the breath features. It depends on many factors, so reliable and valid prognoses can be produced only by the complex multidimensional models. Despite complication our algorithms constitute multidimensional tool facilitating clinical decision making in assessed groups of subjects.

Recent advances in computational analysis of human emotional states allowed better understanding of the so called reverse causal chain between pictures and emotions. Based on aforementioned conceptual and methodological advances our approach can be translated into clinical applications. Based on current advances it is possible to identify emotions caused by pictures as well as solve reverse problem: influence to emotions by planned use of preprogrammed pictures and stabilize affective state.

Using computational analysis of physiological features of emotions can provide real-time data processing, significantly decrease errors of identification and individualization of the stimuli (e.g. taking into considertion individual disposition for a given kind of pictures). It holds the promise to provide more efficient therapeutic options for many patients. Reliability, validity and usability of the device can be enhanced by emotion recognition based on simultaneous measurements of various physiological features from multiple sensors. Such studies are currently conducted by our team.

Directions of further research constitute whole spectrum of possible clinical applications, including mobile. Particular target groups are not only healthy people (e.g. sportsmen, singers, people with stressful job, etc.), and patients with asthma or other severe pulmonary disease, but also e.g. continuous monitoring and stimulation in patients with disorders of consciousness. It may move proposed approach into mainstream of the biomedical research with significant impact on patien-therapist relationship and interpersonal communication. The most recent ideas are aimed at integrated environments with built-in affective computing system.

Another direction of further research is perceived enhancement of the SFM3000 possibilities by another sensors allowing for analysis of exhaled air and early recognition of disturbed features, e.g. in diabetes mellitus or gastrointestinal diseases [9].

Conclusions

Further impact of the proposed solution is hard to overestimate. Such approach can open a novel methods for control of emotions by measure of breathing and appropriate sets of images (e.g. in affective computing applications [10-16]). It may constitute basis for the whole family of new tools: from providing better socioemotional experience to drivers, pilots and air traffic controllers, through assisting people with autism in understanding and operating in the surrounding socioemotional world, to developing new computational models and theories concerning artificial influence to human emotions.

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Conflict of interests

The authors declare no conflict of interest.

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