Omni-Present Biostress Marker using Affective Computing Methodology for Pre-adult Distress

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Abstract

Understanding emotions is an important facet of intimate growth and advancement, and a key tile for the emulation of human perception. Many young people brutalized by an adult, persecuted by oppressor, criminally violated, or witnessed domestic bloodshed react to this brutality exposure by expanding observable, poignant, or learning problems. This leads to the requirement of a stable bio stress marker that address all stress related problems. The existing stress markers have been designed and used for specific task oriented applications which results lack of intelligence and autonomous phenomenon. In addition to that the existing computing methodologies and their qualitative parameters have been very much limited in terms of affective computing utilization which leads to performance in the compromised way. To meet out the challenges, it is proposed to develop automatic classifiers to infer working conditions and stress related mental states from a multimodal set of sensor data. This approach address two methodological and applied machine learning challenges: Detecting work stress using several (physically) unobtrusive sensors, and taking into account individual differences. A comparative analysis is performed among the existing methods for detecting various stress levels.

Keywords: Galvanic skin response, Blood pressure, stress, heart rate, pupil dilation, speech, respiration rate

Introduction

The ability to recognize, interpret, and express emotions play a key role in human communication and increasingly in Human-Computer Interaction (HCI). Recent research demonstrate that humans have an instinctive tendency in interacting with computers. The key research area is building emotionally intelligent interactive system that expresses and responds to human emotions [1]. The main challenge in building emotionally intelligent systems is the automatic recognition of affective states. A person’s emotions such as causal information context and individual traits in addition to information about person’s bodily reactions can be assessed using different sources of information. Understanding emotions is an important facet of intimate growth and advancement, and as such it is a key tile for the emulation of human perception.

Stress is a human body’s method of reacting to a challenge and has harmful effects on health. Many types of stress management therapies are available to decrease stress and to promote well-being. As common definition of stress is different from scientific definition, the current research works concentrate on different aspects of the stress system.

In popular terms, stress is mainly defined as time pressure. Stress is being felt by the persons, who do not have the time to perform the task within a given period. The perception of time pressure usually triggers a set of physiological reactions that indicate the stress level. Every individual would feel stressed when pressured. The
pressure in the form of time which is a highly individualistic experience does not depend on a particular event, but rather depends on specific psychological determinants that trigger a stress response.

Affective Computing has become a popular research area in the field of designing stress marker [2], since human computer interaction is mandatory to read and analyze the stress in various levels for the juvenile age group. According to the existing work, affective computing has shown positive results in detecting human stress. Stress detection has been tackled in various approaches: heart rate variability (HRV), skin conductance (SC), pupil diameter (PD), Finger Temperature (FT) and through speech waves.

On the other hand, the study is on developing automatic classifiers to infer working conditions and stress related mental states from a multimodal set of sensor data (computer logging, facial expressions, posture and physiology) with the help of affective computing that addresses two methodological and applied machine learning challenges which includes detecting work stress using several (physically) unobtrusive sensors, and taking into account individual differences [3]. A comparative analysis of the existing models, to measure out the accuracy and efficiency is important for the field of developmental psychopathology and for society, to tackle the problem.

To meet out the challenges mentioned, it is proposed to develop an unobtrusive, noninvasive measurement method, which is able to assess user affect in parallel with task processing, using only inexpensive standard computer devices with the aim at obtaining ubiquitous sensing stress marker. Additionally, it can acquire physiological markers and correlate these with the affective state having inference on one's performance. A research study indicates the potential of the system to improve social task performance and to induce variations in one's physiological markers. The SWELL Knowledge Work (SWELL-KW) [4] dataset analyzed using Support Vector Machine (SVM) under neutral and stressful working conditions can be distinguished with 90% accuracy.

The peak research areas such as smart bio stress marker design, Human computer interaction, Affective Computing play a significant part in psychological world [5]. The model to be designed is integrated with various domains in order to study the current center performing Research. The survey has been performed in the field of smart Bio stress marker design to fulfill the various applications.

People have distinct ways of negotiating with stress. Some positions that may be motivating to one person, could sense stressful to someone else due to their identity type. Recent research proposed our genes are firmly associated to our personalities and may therefore perceive how receptive we are to stress. The UK's colossal ever online test into stress, attempted by the University of Liverpool and BBC's Lab UK has conceded that rumination is the biggest prognosticator of the most prevalent mental health problems in the country [5]. According to the Mental Health Foundation, rumination and self-blame have been authorized by health specialist as part of the problems.

An outright of 32,827 took part of those were 20,165 women and 12,677 were men from 172 countries. The average age is 39 and they fit to the category of 18-85 years [6]. Most of them were engaged in fulltime working were in balanced relationships took part in the online stress test concoct by the psychologists and BBC's Lab UK at the University of Liverpool, making it the massive study of its kind ever undertaken in the UK.

Luca Chittaro Dept. of Math. & Comput. Sci., Univ. of Udine, Udine, Italy proposed a concept on sound exploration that have a meaningful relation with the events in the application could be used as an alternative to white noise bursts. This device enlarges the applicability of physiological responses over a 3D virtual environment under two circumstances: extent of eye-blink startle retort to alternative sound or white noise interrelated to the occurrence, showing that the two types of acoustic stimuli produce an analogous startle response intensity [7]. Eye-blink startle response could be used in normal ways to enhance the set of physiological measures utilized in affective computing.

Suranga D. W. Gunawardhane Sch. of Comput.,Univ. of Colombo, Colombo, Sri Lanka., proposed a concept on underutilized resource in Affective Computing, key stroke dynamics (KSD), which overviews modern functionality that incorporates a certain level of intelligence and potential benefits of key stroke variations. It is the basis of input that provides an important imminent about an individual's emotional and psychosomatic states. Function oriented character key stroke pattern profile is generated for an individual depending upon his normal typing patterns. This work considers average trained values of correlated features. Real time stress explicit deviations of these trained features are examined to arrive at the individual stress level.

Raffaele Gravina Department of Informatics, Modeling, Electronics and Systems (DIMES), University of Calabria, Rende, CS, Italy projected a concept to identify the Cardiac Defense Response (CDR) with the help of electrocardiogram (ECG) signal. The features originated from the ECG signal, are compared to an adjacent adhoc reference CDR template [8]. This ECG detection method has been tested on real time ECG traces, containing full activations of the CDR pattern.

Automatic Stress Recognition in real-time systems is extremely important to prevent the chronic pathophysiological and psychological stress associated risks. Preamble wearable biosensors monitor the real-life environmental stress, but there is a great variability in how people experience stress physiologically.
On examining humans affective responses to superimposed sinusoidal signals, the signals can be perceived through sound, in case of electronically synthesized musical notes, or through vibro-tactile stimulation, in case of vibrations produced by vibrotactile actuators[9]. Owing to the interactions between perceived sinusoidal vibrations that give rise to a unified percept of a sinusoidal chord.

The most important phase of Automatic Facial Expression analysis recognizing non-verbal cues, is a most important phase of building emotionally intelligent systems [10]. Facial expressions and movements are used either to execute a semantic function for communicating emotions or as conversational cues and further expanded to track and detect facial actions corresponding to the lower features. Further, the facial expression analysis module is integrated with possible sensors to recognize different emotions.

**Methodology:**
1. Identification of Stress
2. Collection of various stress related parameters
3. Determination of stress level by using certain cutoff range .For example the normal heart rate for human being is 60-100 BPM for 18 years and old for children ages 6 to 15, the normal resting heart rate is between 70 and 100 bpm [8]
4. Determine the cortisol slope and the values are transformed to determine which individuals display a consistent profile (flat or typical) and which individuals display an inconsistent profile
5. The diurnal cycle for that individual is characterized as inconsistent and there is a cycle and which individuals display a Flat cycle
6. For the remaining individuals (i.e. those who have not been categorized as Inconsistent), determine which individuals display a typical cycle and which individuals display a flat cycle.
7. To detect the stress identification levels based upon various parameters such as galvanic skin response, facial expressions, speech waves and pupil dilation

**Discussion:**

<table>
<thead>
<tr>
<th>Table I: Comparison of Physiological Parameters</th>
<th>Feature studied</th>
<th>Expected Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV</td>
<td>Low frequency and high frequency component, mean RR interval.</td>
<td>HRV signals on various like mean of heart rates mean of RR intervals, low frequency and high frequency ranges are used to detect stress.</td>
</tr>
<tr>
<td>Pupil dilation</td>
<td>Diameter of pupil</td>
<td>Pupil diameter increased with increase in stress</td>
</tr>
<tr>
<td>EEG</td>
<td>Fpz point, LZ-complexity, alpha relative power and the ratio of alpha power to beta power K-Nearest-Neighbor classifier and Naive Bayesian classifier</td>
<td>Fpz point, LZ-complexity, alpha relative power and the ratio of alpha power to beta power are effective in determining stress but Naive Bayesian classifier is not suitable for the stress prediction based EEG data.</td>
</tr>
<tr>
<td>Speech</td>
<td>Pitch, RMS energy, zero crossing rate, minimum value of amplitude of speech waveform.</td>
<td>Speech variations can be used to detect the level of stress</td>
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<tr>
<td>Respiration rate</td>
<td>Rate of respiration</td>
<td>Breath rate increases with increase in stress</td>
</tr>
<tr>
<td>Electro dermal activity</td>
<td>Skin conductance</td>
<td>EDA increases as stress increases</td>
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</tbody>
</table>

Intelligent bio stress marker systems for pre-adult distress whose activities are sensed by sensor are being built with highly Directive ACM methodology.

**Conclusions:**
The Bio stress marker is employed to avoid unacceptable and often irreversible effects at high levels of biological organization such as disease in humans, mass mortality and loss of commercially or ecologically
important species. Because of the commonality of biochemical and cellular structure and function among organisms, biomarkers are potentially applicable over a wide range of species and across most ecosystem types. Detailed information on biomarkers and their potential for application in evaluating environmental contamination is available. Hence, it would not disturb the other devices operating commercially. The proposed device would be less susceptible to other interference. Also the proposed device would be compatible to the biomarker standards.

REFERENCES