Integrated System for Burnout State Assessment

Yunis Nassar, Razvan Marcus, Andreea Cristina Ionica and Monica Leba

***Abstract*—** The paper proposes a burnout state assessment device and system able to cope with the modern hard-working world syndrome. This syndrome is difficult to detect by first symptoms, usually it is detected when it is too late. This proposed burnout state assessment device provides real-time information on the state-of-stress of the individual, using a low number of physiological parameter signals to have an acquisition system as less invasive and intrusive as possible. Therefore, only three physiological signals are required, namely Galvanic Skin Response, Blood Oximetry and Heart Rate, since these three provide accurate information on the physiological state of individuals. The implementation of proper sensors for the three signals acquisitions require little hardware, being suitable for a wearable device.

***Keywords*—** wearable device, work related, physiological parameter

I. Introduction

THE changes at the economic level have a significant impact to the performance of any organization. But changes came also with new factors that generated the stress of both employees and the entire organization.

The concept of "professional burnout" was first used by Freudenberger [1] to describe the exhaustion symptoms of volunteers who cared for drug addicts in hospitals. But the term was introduced by Mathias Burisch and was described in Graham Green's story "A burnout case", and its oldest use was from a psychological point of view. Subsequently, this concept was included in the literature by Herbert J. Freudenberger, Christina Maslach and Ayala Pines.

Christina Maslach [2] provided the most well-known and used definition of burnout, describing it as an emotional exhaustion syndrome by diminishing emotional resources and decreasing energy, depersonalization at the level of attitudes or negative feelings, insensitivity, lack of compassion, but also the lack of professional achievement in terms of negative evaluation of professional activity, characterized as the decrease of competencies.

The concept of burnout has a very negative impact on the individual level, but also on the social and economic level, thus representing a psychosocial risk that leads to negative consequences for the entire organization. Burnout syndrome determines the occurrence of disorders such as psychosomatic disorders (e.g. gastritis, ulcer, insomnia, tachycardia, bradycardia, etc.), psychopathological disorders (e.g. anxiety, depression, addiction and substance abuse, suicidal ideation) and leads to impairment of a person's physical and mental health.

Somatic and psychosomatic disorders occur along with the symptoms of social dysfunction, making the multifactorial clinical picture. Leiter, M.P., Jackson, N.J. and Shaughnessy, K. [3] departed from the definition of Christina Maslach and described the concept of burnout in terms of "monopathology", considering its composition only in the light of three types of stress symptoms: physical exhaustion (the appearance of physical symptoms), emotional exhaustion (attitudes and feelings) and behavioral symptoms (minimal productivity and workplace dissatisfaction).

The literature shows the stages by which a person can get into the burnout syndrome. These stages are preceded by phases that lead to burnout: for example, the stress phase (there is no longer a match between work and employee resources), exhaustion (anxiety, tension, fatigue), defensive exhaustion (robotization and cynicism with regard to work tasks), enthusiasm (satisfaction in accomplishing tasks), blockage (doubt, uncertainties, unclear expectations), frustration (the appearance of psychosomatic symptoms), apathy and hyperactivity (these phases alternate), the burnout stage (workloads become intolerant and physical and mental symptoms appear). [4]

Until now, questionnaires are known as burnout assessment techniques.

The paper proposes a system that uses both this already validated technique and the physiological parameters Galvanic Skin Response, Blood Oximetry and Heart Rate.

The research presented appears to be a necessity to prevent the occurrence of burnout by creating a profile for each client. The profile memorizes the evolution of the physiological parameters reported to a baseline. The evolution of the parameter values is correlated with the answers to the questionnaires.

If you were to treat burnout as a professional illness, it's easier to prevent than to cure.

The question is: What do business managers need to do to prevent such situations?

It is necessary to identify and eliminate the negative

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influence of risk factors that are reflected in tasks, labor conditions, inappropriate posture and lack of exercise, neurobiological and social demographic characteristics.

The simulation of the influence of these factors will be done by methods already known: hyperventilation is used to simulate stress, and for relaxation talk preparation. The results will become the profile data. It remains to identify the real causes of the influence of environmental factors that have been simulated.

The research method involves two components that work together.

An offline component that involves applying questionnaires, wearable data collection, stress and relaxation simulation, all used in system calibration.

The online component involves wearing the device during the study, in the conditions of the environmental factors in the organization. Corroborated, the two give the user's profile and parameter changes can be interpreted as a useful tool in preventing burnout.

II. Exploring the Possibilities of Identifying the Risk Factors Present in the Assessment of the Burnout Condition

Environmental risk factors responsible for burnout occurrence are external influences on the individual. Not all of these factors are necessarily with negative impact but they can become sources of stress in the workplace. These factors can be related to the following aspects, presented in figure 1.

As a tool of study, we can use the objective ones that show the variations in psychophysiological parameters measured by appropriate devices under the risk factors: cardiac rhythm [6]; oxygen consumption [7]; blood circulation [8]; blood pressure [9]; heart pressure [10]; skin temperature [8]; galvanic skin response [11]; the body's sweat level [7]; dilation of pupils [12]; and as subjective instruments, e.g. NASA - TLX, Subjective Workload Assessment Techniques (SWAT), Defense Research Agency Workload Scale (DRAWS), Borg RPE and CR - 10 scales, Cooper Harper Scale, Modified Cooper Harper, Bedford Scale, Worry-Emotionality Scale, Workload Profile, Instrument for Stress Oriented Task Analysis. Emotional exhaustion can be measured by burnout subscales (e.g., EA of the Maslach Burnout Inventory (MBI)) or by multi-factorial measurements; a single element on systematic evaluation was excluded from the point of view of the measures. All established measuring tools (e.g. MBI, MBI-GS, OLBI) are self-administered as questionnaires.

III. Materials and Methods

The conceptual design of burnout evaluation system comprises two routes: off line and on line.

	Tasks include subjective variables as insufficient rewards, insecure jobs and can be assessed through standardized scales of quality of life at work. Objective variables such as the number of hours worked per week or type of contract provide information on overworking at the workplace. Additional indirect information can be collected by sensors on employees' smartphones (for example, total type of interaction, number of sessions), or by workstations (for example, used applications, keystrokes entered by the keyboard).
	Working conditions, including physical tasks that employees perform within an organization, directly or indirectly affect employee health. Artificial and inadequate light is one of the major issues affecting workloads, with light being introduced using an ambient light sensor with a dedicated device or the smartphone. Noise is also a source of stress for employees who perform their tasks in overcrowded spaces, and this can be measured by advertisements and applications that turn the smartphone into noise-producing sensors (for example, NoiseTube).
	Requirements generate less workplace satisfaction, where employees develop burnout syndrome. Information about users who have social interaction can be inferred from voice / sound analysis (indirect interaction), PC applications (emails, chat programs), smartphone calls and message history (i.e., total number and duration of calls, messages, number of different contacts).
	Inappropriate posture and lack of exercise lead to serious health complications with a negative impact on workloads. Bio-kinetic sensors send a real-time feed-back about body position (for example, lumoBACK) and the intensity of physical activities (for example, FitBit, fitness bracelet). The approximate distance the individual walks on (for example, on foot, on a bicycle) can also be detected with sensors.
	The neurobiological characteristics show that there are some innate predispositions and risks to burnout. Recent discoveries in micro-biometrics (for example, UBIOME) and gene tests that show features and health conditions contribute to the study of genetic predisposition to burnout. [5]
	Socio-demographic characteristics also influence the risk of burnout. This syndrome has a higher prevalence in younger groups, felt differently by men and women. Tools that include demographics, work issues, personality traits (for example, Big Five) are used to collect data to identify the factors that lead to the burnout syndrome.

Figure 1. Environmental risk factors

In off line use, we determine the user profile (6) using dedicated questionnaires (1) for burnout status assessment, measurements from a wearable device (2) about physiological parameters that change due to stress, agitation and other disturbing factors and influential controllable external factors (3). Thus, in the first step an initial calibration involving the use of questionnaires and the parameters from the wearable device will be carried out. These pass through an analytical engine (4) that performs calculations and correlations, the results being loaded into a database (DB) and based on them generating the user's initial profile (6). This profile includes, besides the person's identification data, also the state identified by applying the questionnaires correlated with the measured physiological parameters. Since one state does not provide sufficient data to identify the burnout trend, it is imperative to

identify new states that represent positive or negative deviations from the state identified by the application of the questionnaires. These states are introduced into the calibration stage using the protocol used by [13] in the work which presents methods to induce stress, by using hyperventilation and talk preparation, and to reduce stress. In this way, the minimum required number of states of the user's profile are determined in order to allow to start the real-time identification of the user's state.

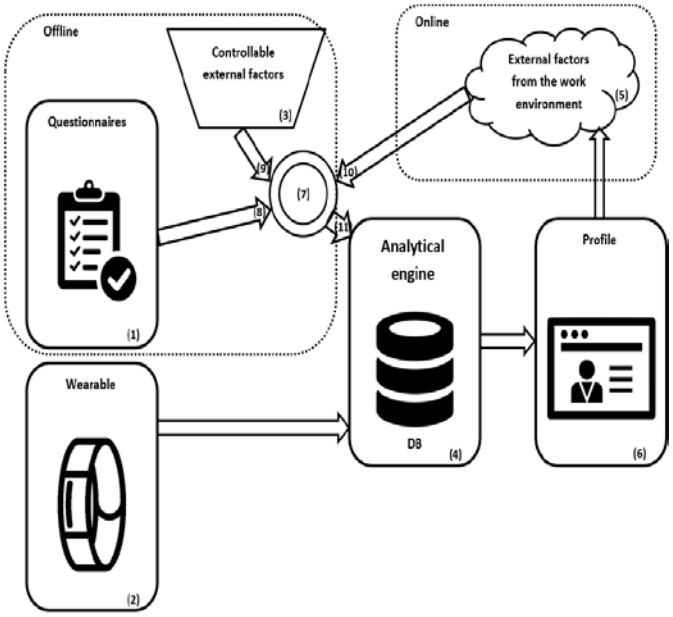

Figure 2. System diagram

Having the completely built-up profile, the same system can be used in the on-line version, in this case the external influence factors are no longer controllable, they are the factors of the environment in which the person lives and works (5). Measurement of physiological parameters is performed continuously, the data obtained pass through the analytical engine (4), are correlated with the person's history, the database is updated (DB) and results an estimation of the current state of the person that will be visible in the user profile (6). Thus, the tendency towards burnout can be detected in real time.

The switch (7) acts as a router in both off line and on line uses. In the offline use receives data from module (1) via link (8) and module (3) via link (9) transmitting (11) to analytical engine (4) for processing. In the on-line use receives data according to the chosen climate analysis protocol only from the module (5) via the link (10) and transfers it to the analytical engine (4) via the link (11).

Next, we present in more detail the wearable part (2) connected to the database (4).

The previous approaches in detecting stress considered several possible signals and their adequate sensors. In this paper we considered the use of three signals: Galvanic Skin Response (GSR), also known as Skin Conductance (SC), Blood Oximetry (BO) and Heart Rate (HR). These three signals were selected based on their properties of being noninvasive when being acquired and because their variation is strongly related to stress stimuli and therefore predisposition to burnout.

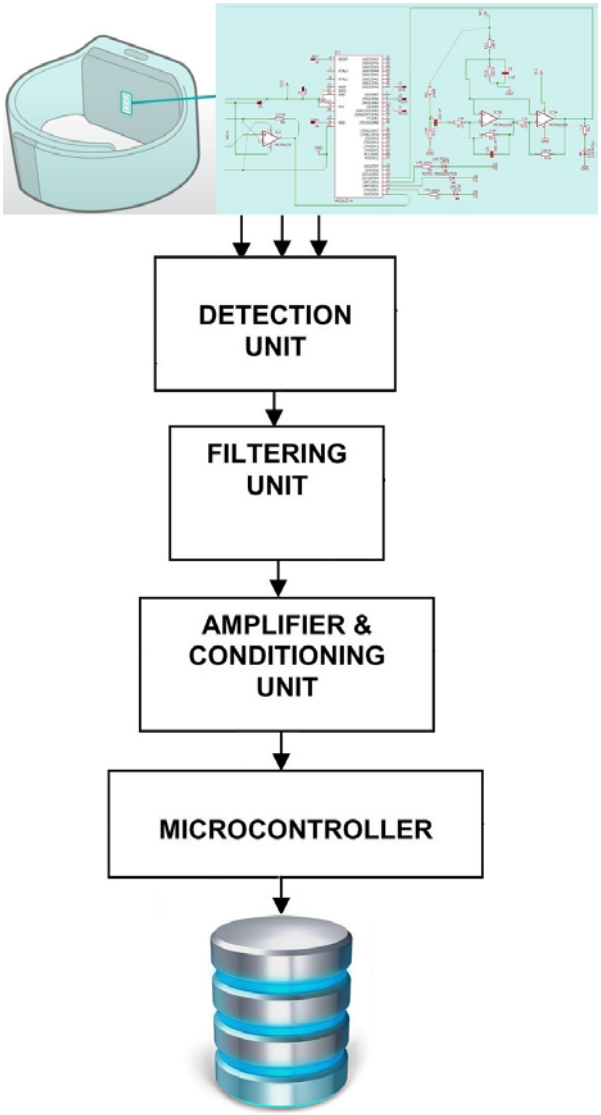

Figure 3. Device block diagram

In figure 3 there is presented the block diagram of the device that delivers the 3 signals acquired by means of a bracelet that integrates the detection unit for the three types of sensors related to the signals identified above, the filtering unit and the amplifier and conditioning unit in order to get the signal prepared to be interpreted by the microcontroller, that sends the computed information to the database to be completed the profile of the user and continuously estimate the current state in order to timely detect the trend towards burnout.

IV. Conclusion

In conclusion, burnout syndrome has become more and more present among employees and tends to transform itself into a global phenomenon, affecting in this way employees of all categories. So, burnout is considered a professional illness that involves an increasing cost for people in different workplaces or even for society, and the concern to evaluate and diminish this topic is growing. However, burnout syndrome is not classified as a work-related disease, and legislation classifies it as work accident, which is an imbalance at a psychosocial level not associated with physical risk. Also, in the case of judicial recognition of this syndrome, the same thing happens. Therefore, there is a need for a normative reform to include this syndrome in the list of occupational diseases, in order to create different programs to prevent this pathology in work. The device and integrated system is both a system for burnout state assessment but most important a system to signal the trend towards this state and prevent it.

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