Review on human stress monitoring system using wearable sensors

Soniya Lakudzode [1], Prof.S.M.Rajbhoj[2]

[1]*PG* Student, Dept. Of E&TC, Bharati Vidyapeeth's College of Engineering for Women, Pune, India
[2]Associate Professor, Dept. Of E&TC *Bharati Vidyapeeth's College of Engineering for Women*, Pune, India

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Abstract - *Chronic stress is regularly found among particular in modern society. However, as it is not able to for physicians to continuously monitor stress levels, its diagnosis is significant. Wireless body sensor networks provide opportunities to everywhere detect and monitor mental stress levels, with improved diagnosis, and provide early treatment. We discuss tradeoffs in system design and sensor selection with related to stress balance information content and wearability. The development of a wearable sensor system to monitor a number of physiological relation of mental stress. Using output signals collected from the wearable sensor, a some selected number of physiological features that show good relation with determine mental stress. However, stress in modern life tends to be spreading widely throughout an area, as it arises mainly from psychological rather than physical effects. As physiological responses to stress are repeated over and over, the result can have more long-term effects on our health. This paper reviews the latest reported systems on stress monitoring of humans based on wearable sensors and issues to be noticed to tackle the challenges.*

***Key Words*: Wearable sensors, sensor networks, body sensor networks, human stress analysis, heart rate variability, skin conductivity.**

1. INTRODUCTION

Stress is big major problems in modern society. Sometimes people are aware of being less stress, for example, when they are busy and active with deadlines of homework and projects; however, long-term conditions with high stress can be short term and long term and people may be less likely to see whether they are under high stress or may be generally less sensitive to stressors. Stress detection and monitoring technology could help more people better way to understand and release stress by increasing their awareness of higher levels of stress that would otherwise go undetected [1]. Many technologies have been developed to find out stress level; some methods are based on physiological signals: blood pressure volume, heart rate , heart rate variability (HRV), skin conductance, cortisol, pupil diameter. Activity of rest and digest and sympathetic nervous system is analyzed through blood pressure volume, heart rate and heart rate variability[1].

1.1 STRESS RELATED PARAMETERS

In many conditions people have medical issues which are known to them but are not ready or unable to reliably go to a physician. Overweight, high blood pressure, irregular heartbeat, or diabetes is examples of common health problems [8]. In these cases, people are usually give suggestion to periodically visit their doctors for routine medical checkups. But if we can provide them with a very quick and more personalized means through which they can get medical feedback, it will save their important time, satisfy their desire for personal control over their own health, and lower the cost of long term medical service [2]. A biosensor is a chemical sensing device in which a biologically derived recognition entity is linking to a transducer, to allow the quantitative development of some complicated biochemical parameter.

Stress is a physical response to the mental, emotional, or physical problem that we noticed. Immediate threats produce the acute stress reaction[9]. The hormones related with stress, such as adrenaline, into the bloodstream to boost concentration. There are also some related physical changes, such as increased heart rate and automatic reflexes. For healthy conditions, the body returns to its normal level after dealing with acute stressors [10]. There are many types of physical signal can be observed from human body, including electrocardiograph (ECG), photoplethysmograph (PPG),body temperature, blood pressure volume, level of glucose and patient activity[13]. Electrical activity of the heart measured with help of ECG over time, normally captured externally from the human body skin.

1.2 EXITING METHODOLOGY

A daily ECG monitoring system requires ten electrodes which are placed to different places of human body and a total of twelve ECG waveforms are simultaneously measured from the human body, are not useful for long-term constant physical monitoring. The heart rate variability of patient, which can be measured by using the variation in RR interval and PP interval is very important physical parameter for long-term health monitoring. The information of wealth can be extracted from the heart rate or heart rate variability. Measurements of cardiac activity are impressive and, with the arrival of consumer-grade heart rate monitors (HRM), relatively cost effective and unnoticeable[3].

2. RELATED WORK

In [1], they find out the overall performance of 15 sets of related features: sleep survey; Big Five ; post survey ;phone survey (morning) ;phone survey (evening) ;CALL ;SMS ; MOB ; SC ;ACC ; COMM ; SCREEN etc. Reorganization take place using six kinds of classifier: 1) Support vector machine (SVM) with linear kernel 2) SVM with Radial basis function (RBF) kernel 3) k-nearest neighbors (k=1-4) 4) Principal component analysis (PCA) and SVM with linear kernal 5) PCA and SVM with RBF kernel 6) PCA and k-nearest neighbors (k=1-4).

In [2], Intelligent Mobile Health Monitoring System collects human's physiological data with the help of bio-sensors. The data is accumulated in the sensor network and a concise of the collected data is send to a patient's personal computer. These devices transmit data to the medical server for determination. After the data is analyzed, the medical server send response to the patient's personal computer. The patients can take necessary actions depending on the response. The IMHMS contains following three components. They are Wearable Body Sensor Network; Patients Personal Home Server and Intelligent Medical Server .

This Sensor Network is created with the help of wearable bio-sensors in patient's body. Collection of important data takes place with the help of these sensors from wearable sensor network. Group leader collected reading from each organ. The communications between group leaders take place with each others. After central controller is transmitting patient's data to the personal computer.

In [3], they presented an approach to detect mentally stressful events using only a heart rate monitor (HRM). The method is related with the principal dynamics modes of Marmarelis, After Heart rate variability analysis done.

In [4], The Galvanic Skin Response (GSR) or galvanic skin level (SCL) is a measure of skin conductivity which is substantial related with human emotional condition during stress and activation level.

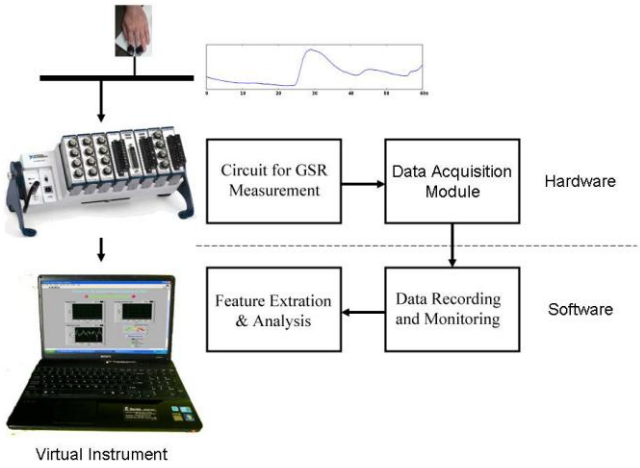

Fig.1. System Setup for skin conductance measurement[4]

Skin conductance level or response (SCL and SCR), is a approach of measuring the electrical conductance of the human skin which varies with human mental and emotional conditions.

For the analysis of galvanic skin response, two electrodes are placed such that the conductive path between them crosses the palm of the hand. Skin resistance or it's reciprocal; skin conductance this variable is used for measurement.

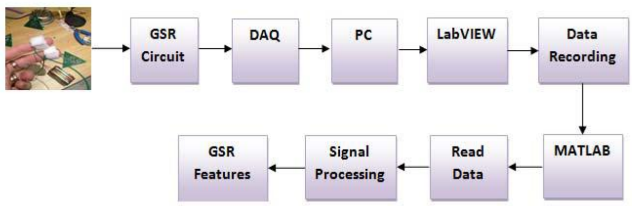

Fig.2. Block Diagram for measuring skin conductance response [4]

Ohm's Law states that skin resistance equals the voltage applied between two electrodes on the skin divided by the current passed through the skin. Hence measuring the potential difference of skin and acquired by data acquisition system.

In[5],They find out a new spectral feature that approximate calculate the balance of the autonomic nervous system by mixing information from the power spectral density of respiration activity i.e. breathe and heart rate variability. They also calculate features like mean , median and standard deviation from skin conductivity level and response. From this they calculate ambulatory stress with the help of logistic regression model.

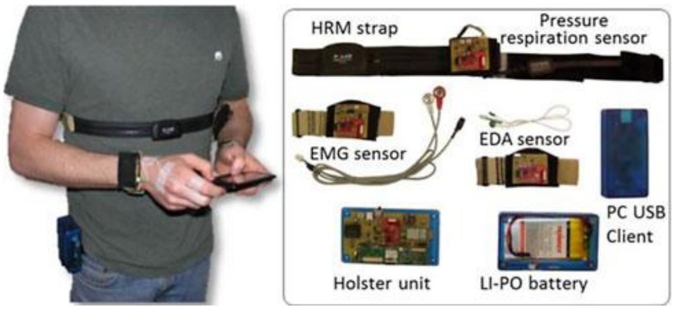

Fig. 3. Snapshot of a subject wearing the full sensor suite [5].

As shown in above figure, with the help of wearable sensors signals like ECG information, skin conductance response and breathe rate is measured. After decomposition of EDA take place in to skin conductance level and skin conductance response.

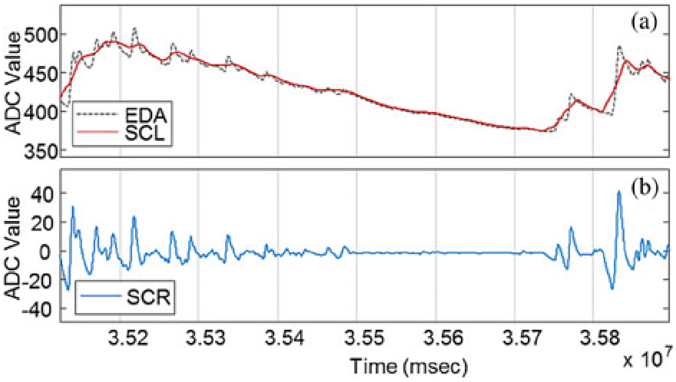

Fig.4. Decomposition of EDA into SCL and SCR (λ = 1500)[5].

ECG information i.e. heart rate variability decomposed into PNS related and SNS related component.

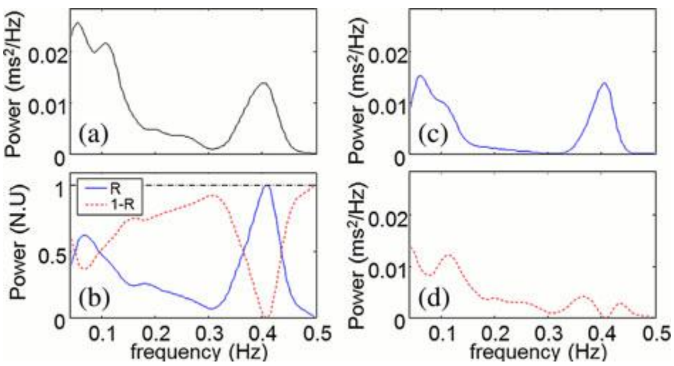

Fig .5.Decompositionof HRV PSD into PNS-related and SNS-related components by frequency weighting according to the respiratory PSD. (a) HRV. (b) Normalized respiration. (c) PNS. (d) SNS [5].

In [6], stated principled machine learning approaches to classifying large data of continuously acquired, multivariate physiological data, with the help of wearable patient monitors, Also gives early warning of serious physiological problem , such that a degree of valuation care may be provided.

In [7], The paper has analyzed the reported literature on wearable sensors and devices for monitoring different human activities. It is revels that many more light-weight, high-performance wearable devices will be available for monitoring a wide range of activities.

3. CONCLUSIONS

Chronic stress is endemic to modern society. Stress can be beneficial, keeping us alert in dangerous situations [1]. Wearable sensors have very useful in some applications such as medical, entertainment, security, and commercial fields. Smart wearable sensors technology will remodel our life, social interaction and activities [2].Stress which is mental, emotional, or physical, making it difficult to monitoring and measurement [3]. If chronic, stress can have serious health problems, an increased risk of coronary heart disease, elevated ambulatory blood pressure, and an increased risk of myocardial infarction. In the long-term, stress can damage the body as it results in suppression of the immune system , inhibition of the inflammatory response, increased blood pressure, damage to muscle tissue, infertility, and diabetes[5]. Hence calculating accurate stress level in human is very important. hence stress related parameter like heart rate variability , breath rate , body temperature and skin conductance level etc are very needed for monitoring and evaluation of human stress level[12]. Stress-related features are obtain from Elect dermal activity, HRV, and respiration sensors using a logistic regression model.

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