

Design and Implementation of Intelligent Human Stress Monitoring System

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ABSTRACT: Stress is increasingly pervasive and a fundamental reason for causing 60% of all human ailments and other diseases. Due to the irregular growing pace of life style, stress has become one of the major reasons causing health issues. Stress is experienced by every person almost every single day which is automatically related to the interconnection between the environment and the person itself. This stress may be a danger sign for their lives. So, it is necessary that people should be aware about the consequences of being over stressed, before it leads to some serious health issues. Therefore, we are designing a continuous Intelligent Human Stress Monitoring System(IHSMS) which will be responsible for monitoring the users'/patients' stress levels and providing the continuous feedback about their stress level' and pieces of information related to it.

It will be helpful to the people about their behavior patterns to quite activities which trigger high stress level and anxieties. Our Intelligent Human Stress Monitoring System is based on a wireless body area networks of Intelligent sensors (W.I.S.E) that transmits vital parameters ideal to record stress levels and changes in the stress level' and then transmits aggregated data via internet to hospital and medical health care facilities where they are continuously being observed. In addition to this, our Intelligent Human Stress Monitoring (IHSMS) system provides online signal processing through LabVIEW. In short, our Intelligent Human Stress Monitoring System (IHSMS) will be very beneficial to health care sectors.

KEYWORDS: Wireless BAN, W.I.S.E, GSR (skin galvanic response), Telemedicine, labVIEW, IHSMS.

1 INTRODUCTION

The term "Stress" is generally defined in biological system as a condition that seriously disturbs the physiological/psychological homeostasis of an organism. Stress is so harmful that it can/may leads to long-term diseases. Stress increases the risk of heart diseases by 40%, heart attack by 25%, and stroke by 50%. In Netherland 1 out of 7 disable gets his condition because of stress at work (TNO survey 2006). Some doctors says, collectively stress is a possible cause for all types of diseases. A little stress is necessary for us but too much stress brings negative impact. Most of the people do not know how to deal with the stressful situations in their lives.

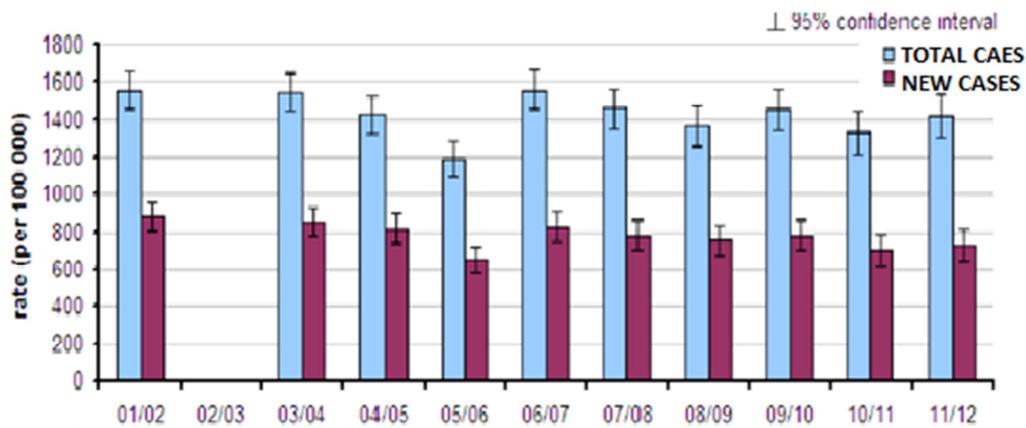


Figure 1. is showing prevalence and incidence rate of work related stress, Depression or anxiety.

In 2011/12 there was an estimated incidence of 86000 male and 135000 female cases of work-related stress based on Labour Force survey. This compares to an estimates prevalence of 175000 cases of work related stress amongst males and 253000 cases of work related stress amongst females. [41] [42]

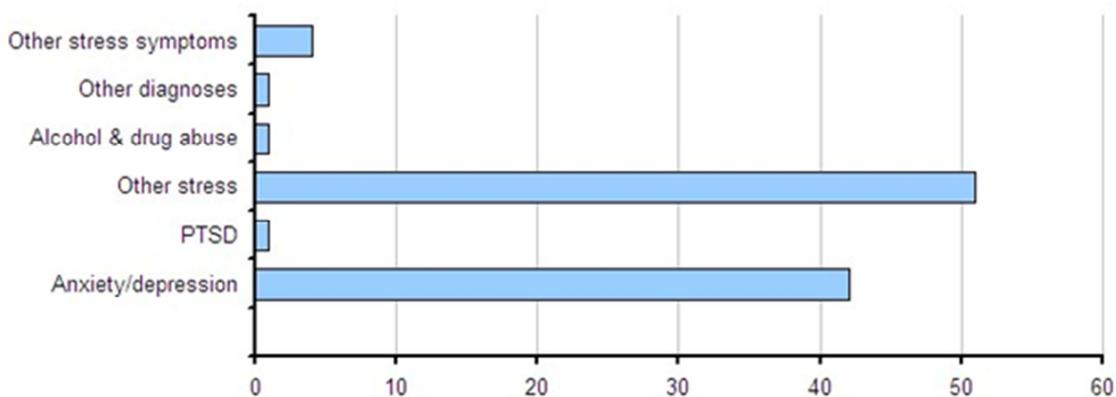


Figure. 2. is showing Breakdown of mental ill health by Diagnosis 2010-2012.

Therefore, we are designing a system that can monitor a person’s stress on daily basis; it helps a person to find that from which situations they get stressed out and what the things they get stress from are. Than it will be easier to find solutions and to get relief from stressful situations and conditions, which is necessary to achieve healthier life style.

2 PREVIOUS WORKDONE

On the market, there are smart phones apps available where people can hold a finger to the camera, which will then detect slight changes in color related to blood flow. With these apps, users can purchase other apps that direct the user

towards stress reduction techniques. However, they do not continuously record stress level. Our goal is to create and combine a continuous stress monitoring device and stress management device into one system. We are using sensor intelligence with the wireless network technology in our system, which will provide reliable and accurate stress monitoring. Our continuous stress monitoring device will be responsible for monitoring the user's stress level, so that the user will be able to concentrate on his/her tasks throughout the day and be assured that stress levels are accounted for.

3 WORKING METHODOLGY

Our Human stress monitoring system combines recent technologies of advance sensors and wireless communication techniques and telemedicine systems. It comprises following parts.

- Sensing/monitoring parameters
- EEG
- ECG and Breathing
- GSR(skin galvanic response)
- Movement sensors(accelerometers)
- W.I.S.E
- PDA(personal digital assistant) device
- Monitoring servers(computers)

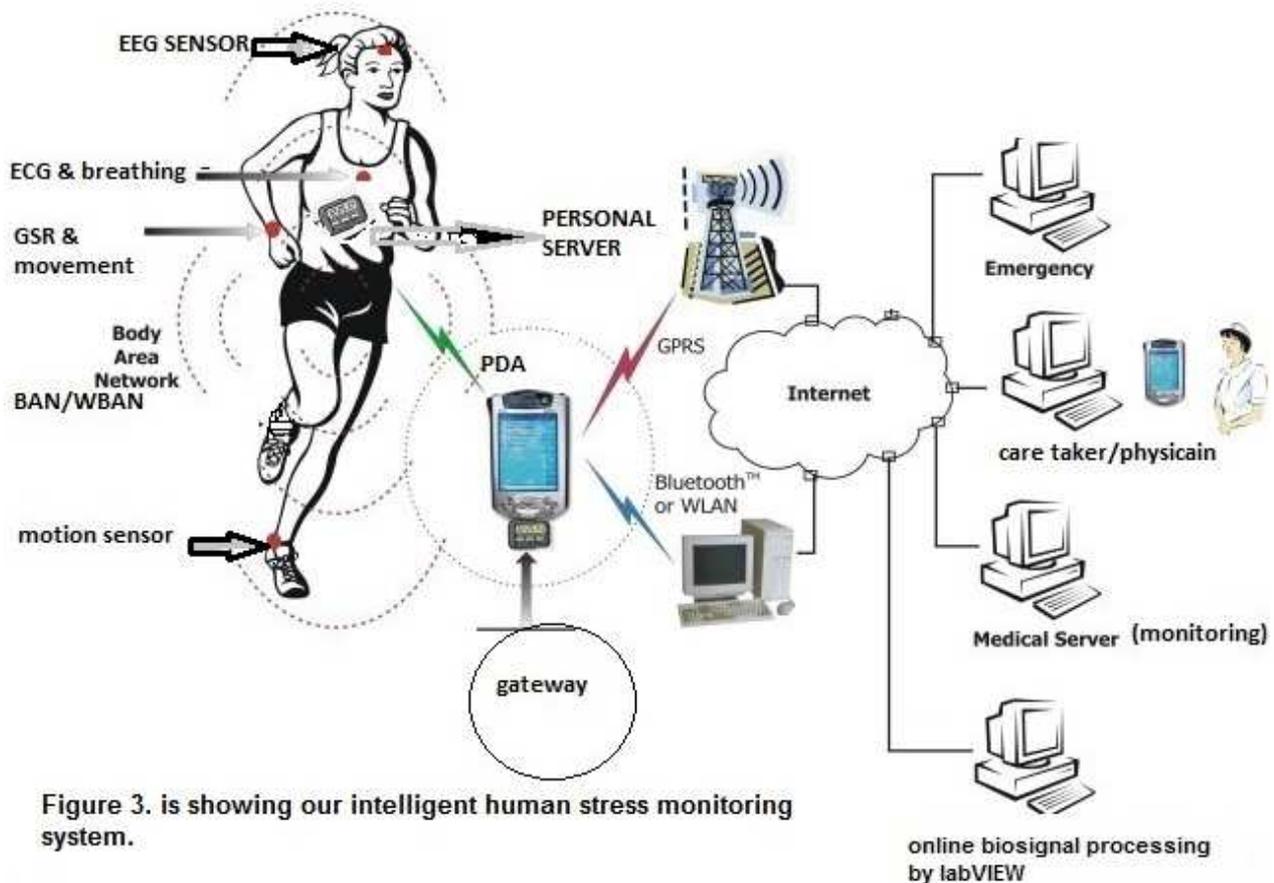


Figure 3. is showing our intelligent human stress monitoring system.

4 DETAILS OF THE SYSTEM

4.1 SECTION 1 (WIRELESS BAN PART)

We are designing a human stress monitoring system based on a wireless body area network (WBAN) of intelligent sensors, which transmits vital parameters (EEG, ECG, temperature etc.) without limiting the activities of the wearer. We have also integrated a BAN (body area network) of wireless intelligent sensors (W.I.S.E) as a development environment for research in the field of mobile health monitoring applications. W.I.S.E is microcontroller- based intelligent physiological sensors that is responsible for data acquisition and low-level real time signal processing tasks. Our BAN is organized as a client server network with a single personal server (PS) and multiple W.I.S.E clients. It's a part of a telemedical system hierarchical signal processing. Individual W.I.S.E sensors are controlled by, and communicate with, the PS using a custom wireless protocol. In addition to its responsibilities as a communication server, the PS also provides synergy of information through data aggregation and higher level signal processing. [8] [9]

4.2 SECTION 2 (TELEMETRY PART)

Now the aggregated measured data is transmitting to the PDA device (gateway). Connection between the PDA and the internet is implemented using Bluetooth IEEE802.11, IR, or a USB cradle. Now the gathered data can be forwarded in real time to the hospital, clinic or medical station through a LAN (local area network), WAN (wide area network). Now the telemedical workstation is responsible for long-term analysis of physiological signals, data presentation, and archiving .Our human stress monitoring system allow an individual to closely monitor changes in his or her stress levels and provide feedback to help maintain an optimal health status by avoiding high stresses. [8] [9]

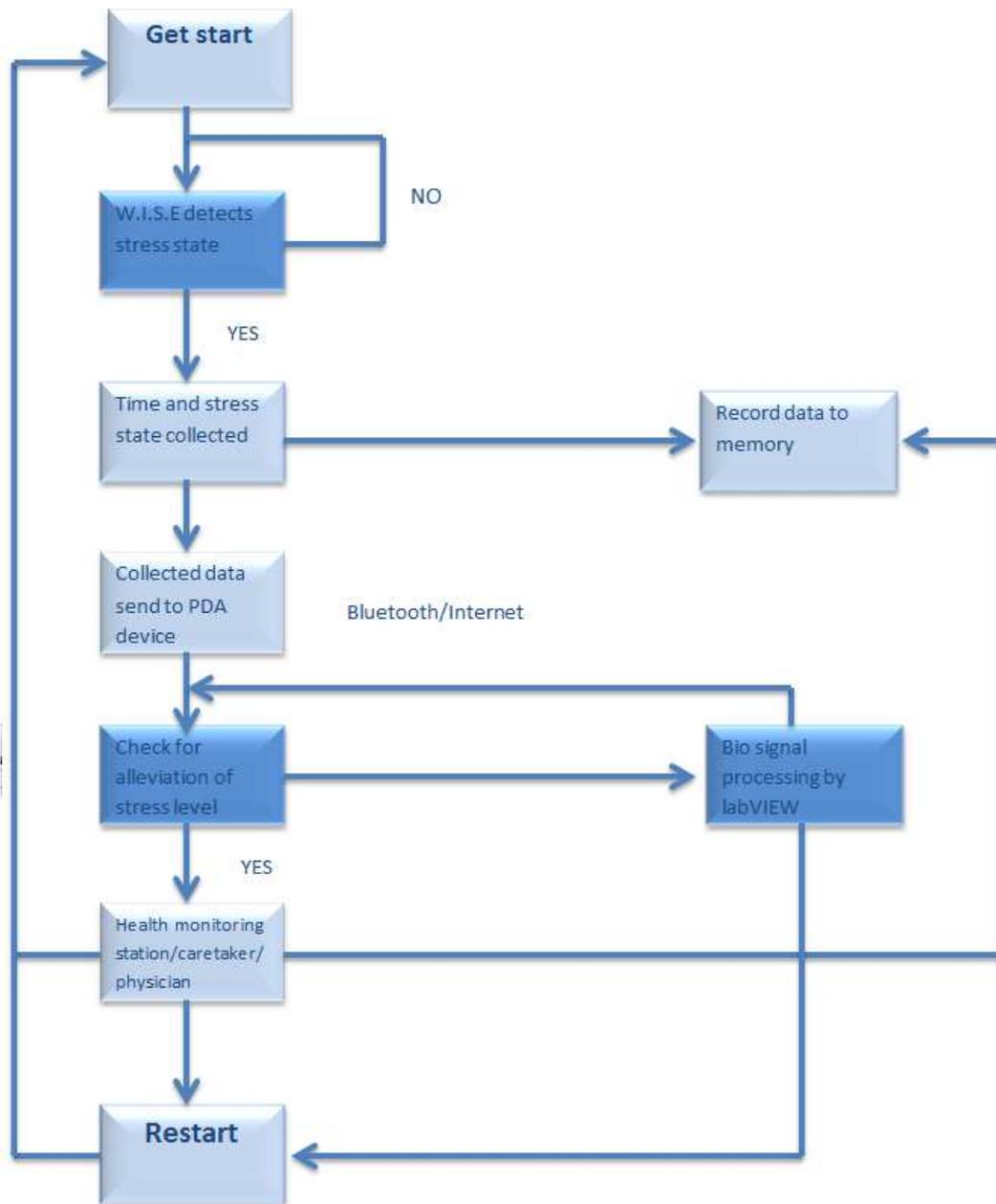
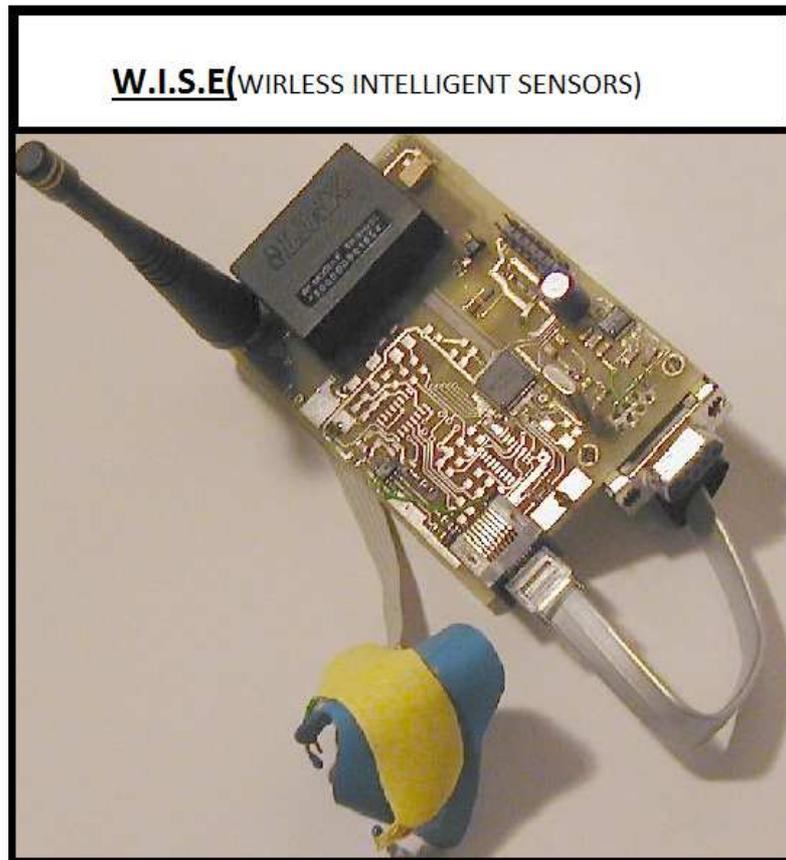


Figure.4 is showing a flowchart of Intelligent Human Stress Monitoring System's working mechanism.

5 W.I.S.E

The core of our wireless intelligent sensor (W.I.S.E) consists of Texas Instruments' microcontrollerMPS430F149 that is responsible for A/D data acquisition and processing, analog signal conditioning, the LINX wireless transceiver module TC-916-SC operating at 916 MHz. The controller features 16-bit RISC architecture, ultra-low power consumption (400 μ in active mode, less than 1 μ in standby mode), 60KB flash memory, 2KB RAM, and a small 64-pin Quad Flat Pack (QFP) package. Our current prototype uses either custom-developed biomedical amplifiers on board or an off-the-shelf two-channel bio-amplifier TETMD A110-1/2 from Teledyne for signal conditioning. It is a battery powered, compact, ultra-low power, analog signal processing amplifier and filter. The signals from the bioamplifier are converted to digital signals using internal 8-channel, 12-bit analog to digital converter on microcontroller. Additional analog channels are used to monitor battery voltage, wireless link quality, and other external analog inputs. Therefore, W.I.S.E is capable of reporting the battery status andgenerating low-battery warnings to the higher system levels. [11][14] [18]



6 ADDITIONAL FEATURES: LABVIEW SIGNAL PROCESSING

One of the features of the LabVIEW application which is meant for online visualizing the measured biosignals and saving them locally is to give the observer, during the stress test, the possibility of setting markers. In this way the different data sets corresponding to the different phases of the stress test can be identified during the offline post processing. [7]

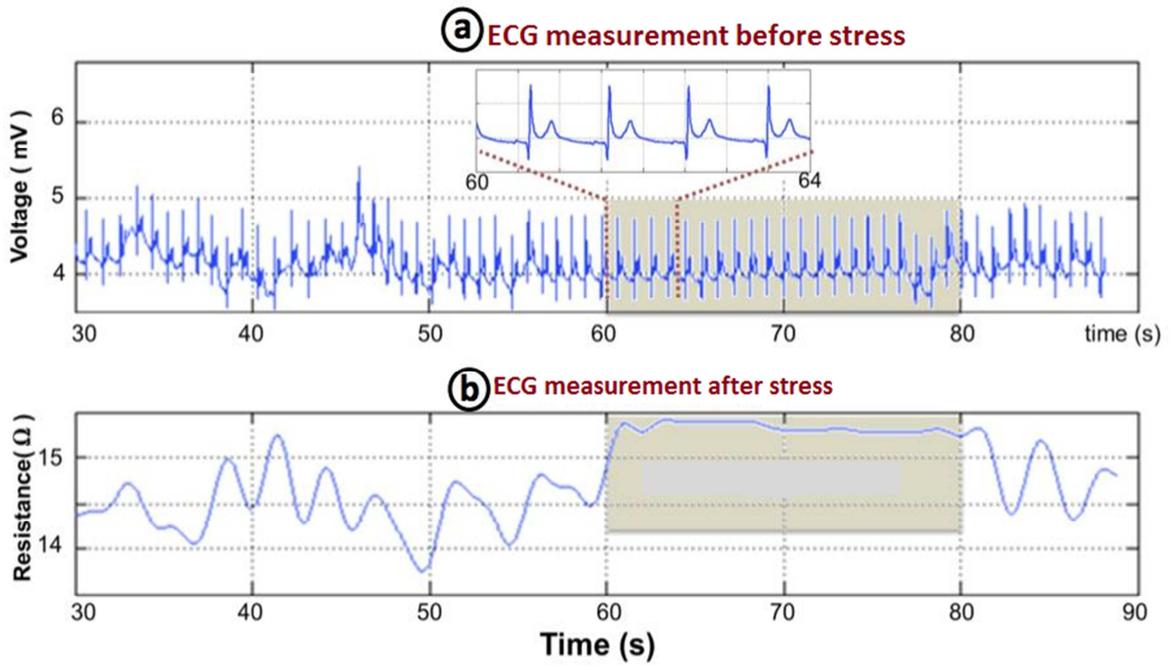


Figure 5. is showing the ECG measurement results before and after stress, results are taken from Intelligent human stress monitoring system.

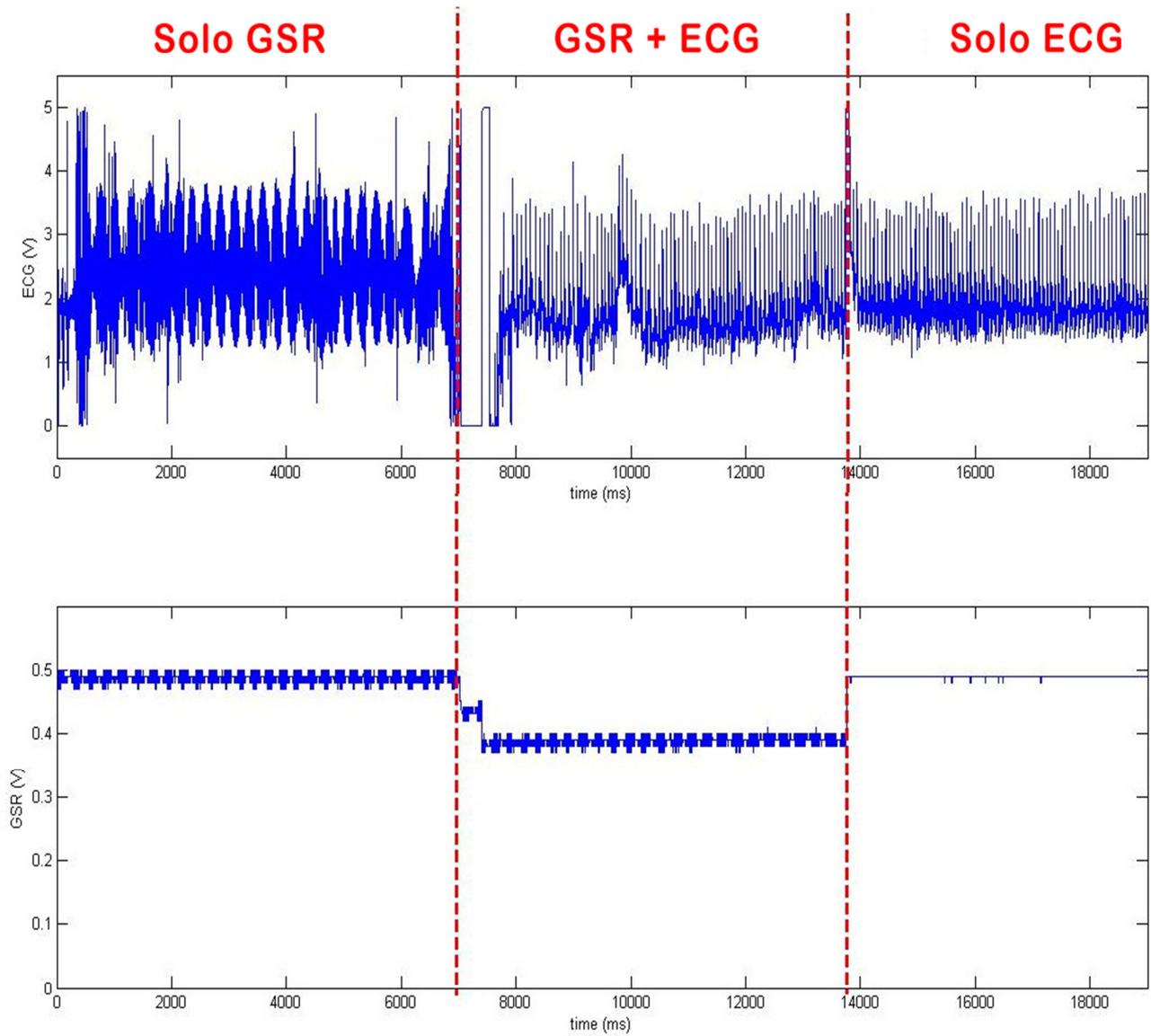


Figure6. is showing the results of ECG and GSR measurements, results are taken from Intelligent huamn stress monitoring system.

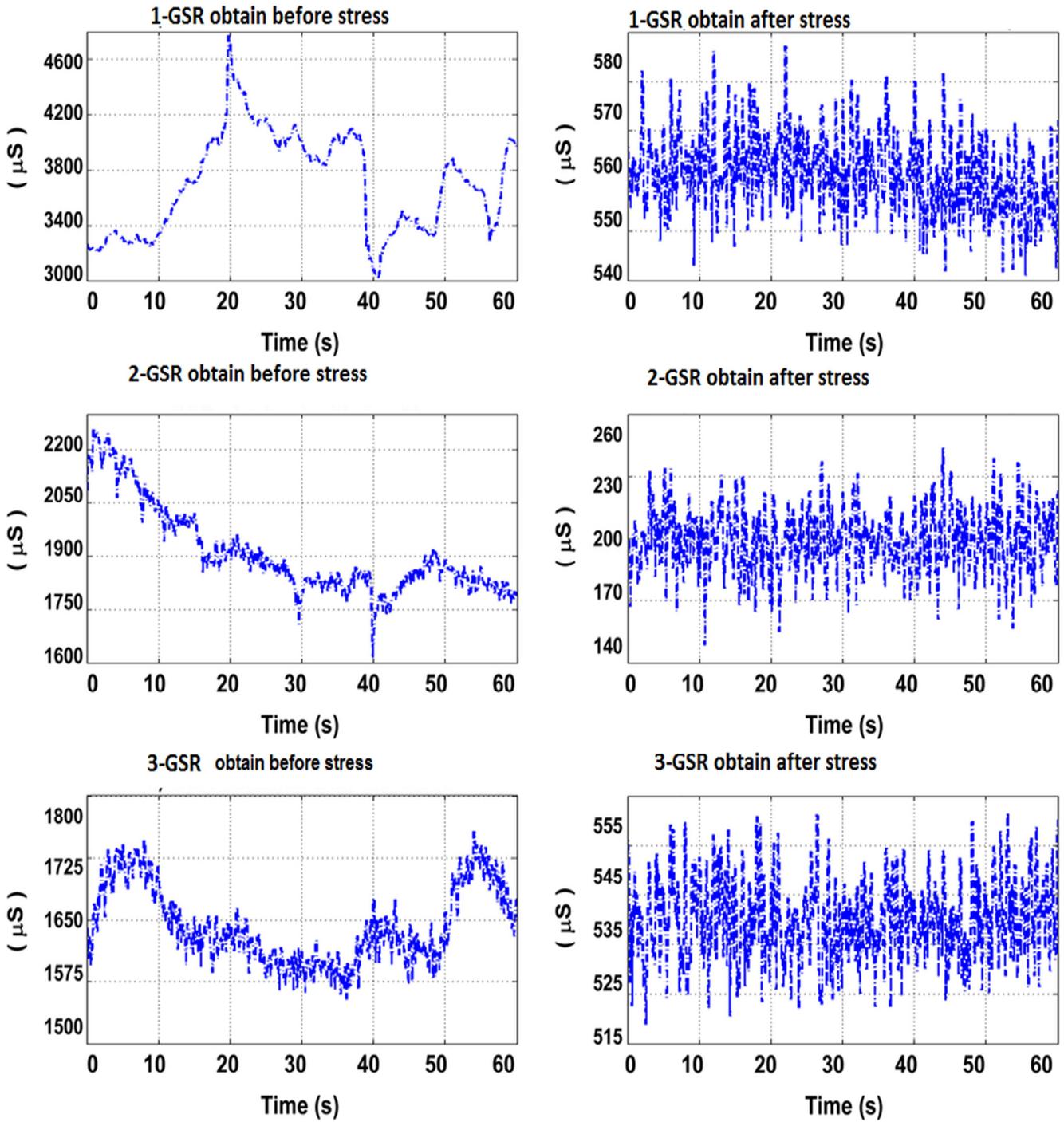


Figure 7. is showing the results of GSR measurements, results are taken from Intelligent human stress monitoring system

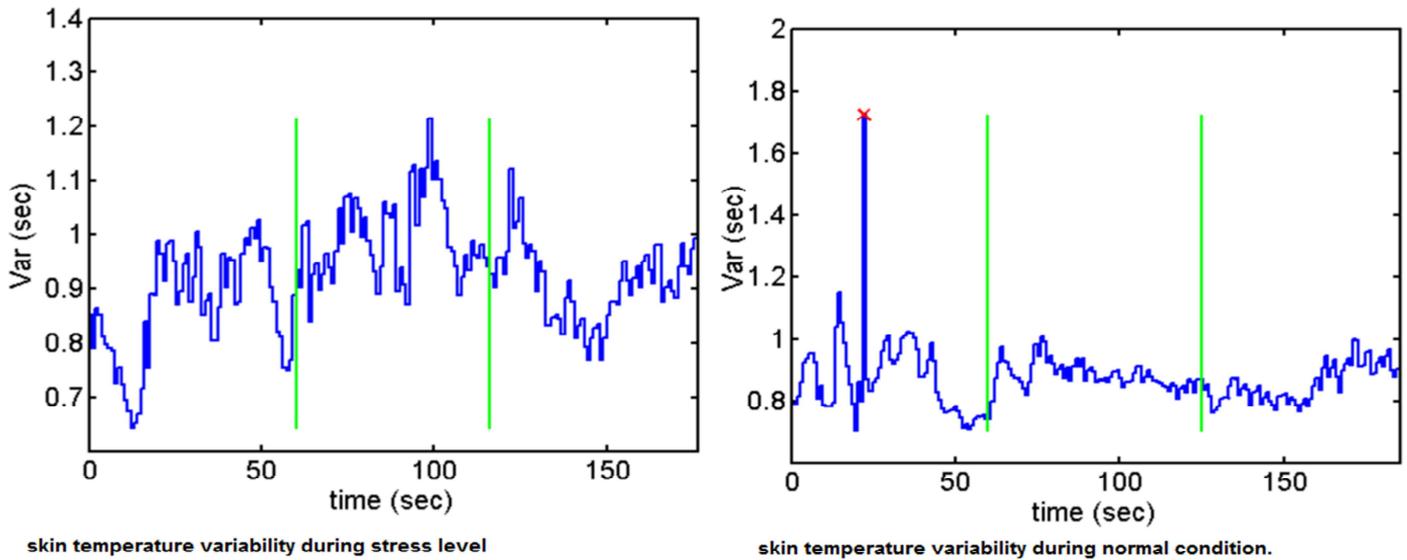


Figure 8 is showing skin temperature variability during stress level and in normal condition.

7 APPLICATIONS

There are many applications of Intelligent Human Stress Monitoring system (IHSMS). If a person already having chronic diseases (high blood pressure, arrhythmia, etc.) or if he/she cannot manage stress so, it leads to long term illness and more complications. Therefore, before curing stress or other illnesses, we have to monitor measure and manage stress which is ultimately the main application of Intelligent Human Stress Monitoring System. Moreover, it will be beneficial to soldiers, firefighters, police officers, and athletes, meeting participants and many others so that they can easily manage their stress and anxiety and can perform their actions in a more productive way.

8 CONCLUSION

It is noteworthy that intelligent human stress monitoring system is crucial for detection of stress. Our intelligent human stress monitoring system promises to revolutionize health care by allowing inexpensive, non-invasive, continuous and ambulatory health monitoring with almost real-time updates of stress level .so that patients can benefit from continuous long-term monitoring as a part of a diagnostic procedure. Therefore, they can achieve optimal maintenance of a chronic condition. Furthermore, in this way our intelligent human stress monitoring system is providing a solution that can help to achieve healthier life style.

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