MENTAL HEALTH MONITORING SYSTEM

Gaurav, Kishan Singh, Akash Sharma ,Akash Goswami ,Sanjeev Kumar Saini ,Manish Patel
Department of Electronics and Communication Engineering
ABES Engineering College, Ghaziabad, Uttar Pradesh, India

***Abstract*—Stress is a feeling of emotional or physical tension. It can cause from both physical and emotional reason like chronical disease, depression, negative thoughts, self-doubt, anger etc. It is both positive and negative. Positive stress helps in avoiding danger or deadline but when it lasts for longer period, it may harm your health and mind. To prevent last long stress, it is necessary to detect them in the early stages which is only possible if detects on time. In this paper, a comprehensive review has been presented which focused on stress detecting and monitoring using wearable sensors, Electroencephalography (EEG), Electrocardiogram (ECG) and photo plethysmography. The stressors techniques, results, advantages, limitations and issue for each study are highlighted and expected to provide a path for future research studies and multimodal stress detection based on deep learning technique has been proposed at last.**

Keywords— Stress, Emotions, Galvanic Skin Response (GSR), Global System for Mobile Communication (GSM), Arduino (Microcontroller), Pulse Rate.

I. INTRODUCTION

Stress is body 's response marked by anxiety, depression, tension or kind of extreme discomfort and distress for an individual. Stress can be of both positive and negative. Positive stress helps in preventing deadlines, or helps in developing skill of performing task under pressure [1]. For some people it acts like a adrenaline booster who wants challenging life and they consider it as a affirmative reaction. This positive stress is called Eustress .This stress is mostly felt by people when result of situations are expected to be positive like when competing for competitive exams ,or during child birth. Stress which affects lifestyle in negative way it lasts for long duration, it may lead to various health related issues which harm individual both physically and mentally. It leads to decline in physical performance and mental peace which adversely affect the brain and body of person.

Hard professional life and internal simulations like mood feelings and behavior can also lead to stress. Personal stress like death of loved ones, chronic illness, legal problems caused stress. Therefore, it is matter of great concern to detect stress as soon as possible and provide treatment to person who is going thought it [2][3].

II. LITERATURE REVIEW

Humans now started adapting the stress and created the feeling adaptable and allay with the flow. They are not seeing the side of the stress on their health, even the very less level of stress can cause a significant and very dangerous amount of damage to the human body, so it very important to awake of cautions of stress overload and their symptoms [4][5].

Hard professional life and internal simulations like mood, feelings and behavior can also leads to stress. Personal stress like death of loved ones, chronic illness, legal problems caused stress and so on the urgent basis person need to rectify the stress related problems, so he can live there with peace.

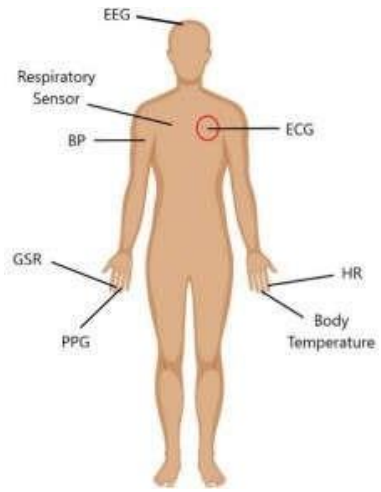

Fig. 1: Physiological parameters for Stress Monitoring [19]

A. Physiological Signals and Emotions

Multiple signals like electrocardiogram (ECG), electroencephalogram (EEG), galvanic skin response (GSR), electromyogram (EMG), arterial blood pressure (ABP) [3-6] are used to determine whether the person is under stress or not or what is level of stress like low, medium and high .to lessen data processing cost and improve real time conditioning one or more signal ECG or GSR is used [7-9] .and Crying detection [10,11,12,13] scheme was proposed to examine stress in children accompanied by various machine learning approaches like k-nearest neighbor [12].

B. Related Work

The stress was measured by the authors [12] in which they used the heartbeat, GSR hand, EMG, and breathing records which results breathing the most important criteria in measuring the stress. In a research work [13], ECG (Electrocardiogram) signals were used by the authors for measuring the stress. Indicators like electrocardiogram

(EEG), Galvanic Skin Response (GSR), electromyogram (EMG) and SPO2 and different sequence & technique were used for the finding of stress [14][15]. There is different value which assigned to different index which used for measuring the stress level, this value is calculated and verified by the data received from the all sensors. A computer based algorithm was used by author, in which samples were taken from 16 peoples under 4 unique condition of stress and its data is measured by the help of SMO, BNA (Bayesian Network algorithm). In [16], stress level prediction was done by authors using the two physiological signals; one was HRV features derived from ECG and the other one is EEG signal. A set of data is obtained from completion of two process and stress is measured by applying tree decision algorithm [17]. In a research work carried to monitor the stress levels of students during their semester studies, stress of the college students was measured when they are in first semester and when they are in last semester. The authors demonstrate quite interesting results mentioning the stress is minimum in first semester and maximum in last semester [4]. The main problem faced by the researcher's is that how to get maximum accuracy by the physiological signals and report get by conducting survey on different people living in different areas and after long research they found a way to get more accurate results.

Table 1. Review of different emotion monitoring methods using physiological signals.

Author	Physiological Signals/ Features	Methods used	Accuracy
[18]	ECG time intervals and statistical features.	Linear Discriminant Analysis (LDA)	61.79 %
[19]	Skin conductance (SC), Blood volume pulse (BVP), Respiration.	Data correlation, threshold calculation using experiment.	-
[20]	Eye Blinking Frequency (BF), Pupil Dilation (PerLPD) Pupil Ratio Variation (PRV).	A Dynamic Bayesian Network (DBN) a directed acyclic graph (DAG) conditional probability table (CPT).	80%
[21]	Heart rate variavility (HRV) and Electrodermal Activity (EDA).	Support vector machine classifier	78.43%
[22]	ECG + EEG	Multilayer Perceptron Network (MLPN) and Support Vector Machine(SVM)	97.2%
[23]	Galvanic Skin Response (GSR)	ANOVA	95.83%

III. MATERIALS AND METHODS

In this paper, we are discussing how we are going to make stress monitoring system which predicts the stress level of the human beings. For this device we require several equipment that are the ECG sensor, heart rate detector, Skin conductance sensor, a controlling device, photodiode, LEDs, etc. First physiological signals are measured using sensors and provided to input ports of the microcontroller. A threshold based algorithm is used to compare the real time values of physiological parameters with the standard cutoff levels to detect the stress level of a person.

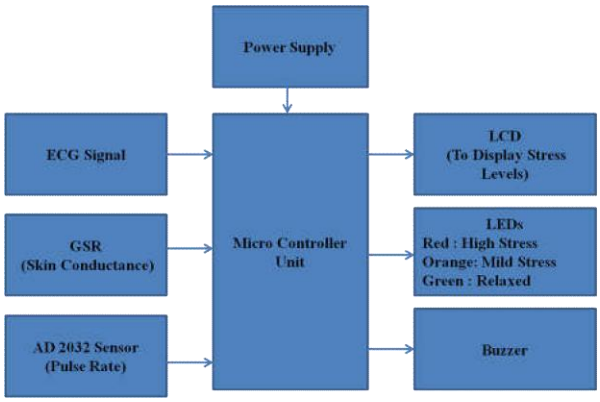

Fig. 2: Block Diagram of stress monitoring system

The stress levels are displayed on the LCD that may be a high stress, mild stress, or relax state. The three stress levels are also displayed using three different color LEDs. There is also a alarming system in case of high stress levels. A general block diagram for stress detection using physiological sensors is shown in figure 2. The main components of the system are discussed below.

A. GSR Sensor:

GSR or galvanic skin response is used to measure the skin conductance of the human which change with the interaction of human with environment, and individual's psychological state. The skin conductance can be measured using skin electrodes attached to fingers (figure 3). Skin conductance changes with the stress or emotion situation of a person and the corresponding electrical signal can be used as an indicator of emotion. GSR sensor measures the electrical signal associated with skin conductance.

Fig. 3 GSR electrodes attached to fingers

B. *Pulse Rate Detector:*

Pulse rate detector is an optical device which main function is to measure the heartbeat by pulse wave, which are changes in the volume of a blood vessel that occur when the heart pumps the blood. For the detection of the heart rate, we are going to TCRT500 L that consist of infra ray emitter and phototransistor .in this device person need to put one finger inside the detector and gives the output as the heart rate count.

C. *ECG:*

EGC or electrocardiogram is a process or test that is use to measure the activity and rhythm of the heart the sensor which id use to measure the ECG of a person is AD8232 it take the electrical signal form the skin of the human per beat .it gives the output in the form of PQRS wave diagram which we usually called graph

D. *Arduino uno :*

The Arduino uno is an open-source microcontroller board based on the microchip AT mega 328p microcontroller and developed by adenocyte with sets of digital and analog input/output(I/o) pins that may be interface to various expansion boards and other circuit. In the Arduino uno ground input is used as the stress state and input voltage (5Volts) as an input relaxed state. Coding is done in Arduino uno in such a way that it takes the time from the input and measure the RTC and also test again to make sure output is accurate without any error.

IV. CONCLUSION

This paper presents a study of the automated methods used for emotion monitoring under different stress scenarios. The goal of this study is to provide a summary of available methods for emotion monitoring systems so that further work in this direction can be done. The study demonstrates that physiological signals like skin conductance, pulse rate, and electrocardiogram can be significantly utilized as indicators for emotion or stress level identification. However accuracy of such system greatly depends on the selection of features of physiological signals as a marker of emotions. A computer based automatic system can be developed using advanced machine learning methods and Internet of things (IoT) to remotely monitor the emotions of a person on a mobile device.

REFERENCES

[1] M. Schels, S. Scherer, M. Glodek, H. A. Kestler, G. Palm, and F.Schwenker, “On the discovery of events in EEG data utilizing information fusion,” Comput. Stat., vol. 28, no. 1, pp. 5–18, 2013, doi: 10.1007/s00180-011-0292-y.

[2] A. Dzedzickis, A. Kaklauskas, and V. Bucinskas, “Human emotion recognition: Review of sensors and methods,” Sensors (Switzerland), vol. 20, no. 3, pp. 1–41, 2020, doi: 10.3390/s20030592.

[3] Atlee Fernandes, Rakesh Helawar, R. Lokesh, Tushar Tari and Ashwini V. Shahapurkar “Determination of Stress using Blood Pressure and Galvanic Skin Response” 2014 International Conference on Communication and Network Technologies (ICCNT), 2014.

[4] J. Kumari, R. Rajesh, and K. M. Pooja, “Facial Expression Recognition: A Survey,” Procedia Comput. Sci., vol. 58, pp. 486–491, 2015, doi:10.1016/j.procs.2015.08.011.

[5] S. S. Kulkarni, N. P. Reddy, and S. I. Hariharan, “Facial expression (mood) recognition from facial images using committee neural networks,” Biomed. Eng. Online, vol. 8, pp. 1–12, 2009, doi: 10.1186/1475-925X-8-16.

[6] B. Basharirad and M. Moradhaseli, “Speech emotion recognition methods: A literature review,” AIP Conf. Proc., vol. 1891, no. October, 2017, doi: 10.1063/1.5005438.

[7] A. Fernandez-Caballero et al., “Smart environment architecture for emotion detection and regulation,” J. Biomed. Inform. vol. 64, pp. 55–73, 2016, doi: 10.1016/j.jbi.2016.09.015.

[8] Y. Gu, S.-L. Tan, K.-J. Wong, M.-H. R. Ho, and L. Qu, "A biometric signature based system for improved emotion recognition using physiological responses from multiple subjects,"in 8th IEEE International Conference on Industrial Informatics (INDIN), 2010 Osaka, 2010.Survey,” vol. 43, no. 4, 2011, doi: 10.1145/1978802.1978815.

[9] K. Kim, S. Bang, and S. Kim, "Emotion recognition system using short- term monitoring of physiological signals," Medical and Biological Engineering and Computing, vol. 42, pp. 419-427, 2004.

[10] B. Schuller, G. Rigoll, and M. Lang, “Hidden Markov model-based speech emotion recognition,” in 2003 IEEE International Conference on Acoustics, Speech, and Signal Processing, 2003. Proceedings. (ICASSP’03)., 2003, vol. 2, pp. II–1, doi: 10.1109/ICASSP.2003.1202279.

[11] M. Jain et al., “Speech emotion recognition using support vector machine,” Arxiv, 2020, doi: 10.5120/431-636.

[12] S. Ramakrishnan and I. M. M. El Emary, “Speech emotion recognition approaches in human computer interaction,” Telecommun. Syst., vol. 52, no. 3, pp. 1467–1478, 2013, doi: 10.1007/s11235-011-9624-z.

[13] W. Lim, D. Jang, and T. Lee, “Speech emotion recognition using convolutional and Recurrent Neural Networks,” in 2016 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA), 2016, pp. 1–4, doi: 10.1109/APSIPA.2016.7820699.

[14] M. Wollmer, A. Metallinou, F. Eyben, B. Schuller, and S. Narayanan, ¨“Context-sensitive multimodal emotion recognition from speech and facial expression using bidirectional LSTM modeling,” Proc. 11th Annu. Conf. Int. Speech Commun. Assoc. INTERSPEECH 2010, no. September, pp. 2362–2365, 2010.

[15] A. Fathullah and K. Willis, “Engaging the Senses: The Potential of Emotional Data for Participation in Urban Planning,” Urban Science, vol. 2, no. 4, p. 98, Sep. 2018.

[16] V. Achuthan Babu , A. Sureshkumar , P. Suresh Babu, "Facial Expression Recognition using Deep Learning", International Journal of Engineering Trends and Technology, vol. 67, no. 3, pp. 131-134, 2019.

[17] I. J. Goodfellow et al., “Challenges in representation learning: A report on three machine learning contests,” Neural Networks, vol. 64, pp. 59–63, 2015, doi: 10.1016/j.neunet.2014.09.005.

[18] K. Rattanyu, M. Ohkura and M. Mizukawa, "Emotion monitoring from physiological signals for service robots in the living space," ICCAS 2010, 2010, pp. 580-583, doi: 10.1109/ICCAS.2010.5669914.

[19] S. Gedam and S. Paul, "A Review on Mental Stress Detection Using Wearable Sensors and Machine Learning Techniques," in

IEEE Access, vol. 9, pp. 84045-84066, 2021. doi: 10.1109/ACCESS.2021.3085502.: 84045-84066 (2021)

[20] W. Liao, W. Zhang, Z. Zhu and Q. Ji, "A Real-Time Human Stress Monitoring System Using Dynamic Bayesian Network," 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05) - Workshops, 2005, pp. 70-70, doi: 10.1109/CVPR.2005.394.

[21] Kim KH, Bang SW, Kim SR., "Emotion recognition system using short-term monitoring of physiological signals", Med Biol Eng Comput., vol.3, pp. 419-427, 2004 . doi: 10.1007/BF02344719. PMID: 15191089.

[22] Deepika Koundal and Saeed Mian Qaisar, "Stress Classification by Multimodal Physiological Signals Using Variational Mode Decomposition and Machine Learning", J. of Healthcare Engineering, vol. 22, 2021.

[23] Memar, M., Mokaribolhassan, A., "Stress level classification using statistical analysis of skin conductance signal while driving", SN Appl. Sci., vol. 3, no. 64, 2021.