Chapter 6
Design of Healthcare Assistant Using EEG Signals for Stress

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ABSTRACT
Stress is a matter of concern for every age group. In this chapter, the author has focused on the age group 17-24 (five males and five females), who have just completed senior secondary and entered into an undergraduate course, who are vulnerable to cope up with the situation of transition. The focus of the chapter is on the design of the study protocol to identify stress levels by using induced stress tests like Stroop color test and arithmetic three-level (easy, medium, and hard) test. Data is divided into bands delta theta alpha beta and gamma by using four levels of discrete wavelet transform, and features extracted are Hjorth parameters activity, mobility, and complexity from the combination of channels and band levels. The accuracy achieved for stress and no-stress for male vs. male, female vs. female, and male vs. female is in the range 93-98% for the combination of channels at the frontal position and at band delta theta alpha beta and gamma whereas less involvement has been observed for other lobes parietal, temporal, and occipital.

INTRODUCTION
Electroencephalograph (EEG) measures the electrical activity generated at the scalp level of the brain by fixing electrodes at the designate position as per the requirement of the study. For the selection of position for electrode placement broadmann atlas is the appropriate guide to navigate. Generated signals gives the insight of various neurological changes happened inside the brain during the time of data capture. It is invasive process and easy to conduct with expertise in handling the device. For the placement of electrodes on scalp standard 10-20 or 10-10 positioning are convenient. Figure 1 shows the signals generated from the scalp of subject. In literature signals generated by using EEG device has been used for various purpose. In (Gupta, V., Chopda, M. D., et al. 2018) cross subjects’ emotion has been identified by using analytic discrete wavelet transform. Signals generated are not limited for the usage of non-critical things but can be used as clinical support parameters in (Sharma, R. R., & Pachori, R. B. (2017), Sharma, R.

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R., Varshney, P., et al (2018), Bajaj, V., & Pachori, R. B. (2011)) author has used the signals for the epilepsy subjects by using the technique time frequency representation, iterative filtering and empirical mode decomposition respectively. In (Sharma, R., Pachori, R., et al. (2015), Alarcao, S. M., & Fonseca, M. J. (2017), Bajaj, V., & Pachori, R. B. (2014, May)) the various possible emotions are identified by using EEG signals and the techniques used are intrinsic mode functions and multiwavelet transform. In this chapter author have used the discrete wavelet transform for the division of the signals at band levels and features extracted at band levels are hjorth parameters activity, mobility and complexity.

**DESIGN OF STUDY PROTOCOL**

To conduct any study selection of appropriate subjects is just like building strong foundation to construct the building. It may include age, gender, demographic details and so on. In this chapter focus is on age group 17-24 and study is to identify changes in physiological signals in case of stress and non-stress situation for the male and female. Non stress situation is identified as baseline represented by rest in proposed approach as shown in figure 2. Three baseline data has proposed to capture to clearly discriminate stress signals from non-stress signals. There are various stress induced tests are available in literature, few of them proposed in this chapter are arithmetic test of 3 level of difficulty (Simple/Medium/Hard), and Stroop color test (Hamilton, M. (1960), Friedman, I. A., & Bendas-Jacob, O. (1997), Golden, C. J., & Freshwater, S. M. (1978), McLean, J. F., & Hitch, G. J. (1999), Sdika, M. (2010), Olah, M., Patrick, E., et al. (2018), Paxinos, G. (2016), Nowinski, W. L., & Bryan, R. N). Readers can read about these test from the articles in reference 8 to 15.In this study for the identification of appropriate subjects screening test has been conducted as shown in figure 3. For the screening purpose offline arithmetic test is conducted. The procedure followed was subjects have asked to solve the given arithmetic test by providing enough time to complete. In next phase time has decreased by 40% at an individual level with the intention to induce the stress as a factor of lack of time which leads to mistake. The answer sheets have been evaluated and the only subjects as shown in figure 3 has been included in the study who has score difference in marks are greater than 40, rest volunteers have excluded from the study.
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