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CHANCHAI SUPAKITAMONPHANE : A STUDY ON THE DESIGN AND
CONSTRUCTION OF EMG AND HEART RATE MONITORS FOR MENTAL STRESS
DETECTION AND MANAGEMENT. THESIS ADVISORS : CHUSAK VEJBAESYA,
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Nowadays, detection and monitoring of mental and physical stress by employing medical instrument via muscle tension and heart rate can be used to prevent and/or treat stress. Although the biofeedback technique has certain benefits in detecting and managing mental stress with a non-invasive method, but the instruments used for the technique are expensive and inconvenient.

The purpose of this thesis is to design and construct a medical instrument integrating both electromyograph (EMG) and heart rate (HR) monitoring at affordable cost. The instrument is portable, not so complicated for operation, and low cost. Locally available material and components were used for the construction. Besides, the analog and digital output display provides simpler interpretation which does not require much experience to use. This constructed set consists of two monitoring systems which are EMG monitor and HR monitor. The output can be displayed on panel of the device with numerical values of EMG mean amplitude and beat-to-beat per minute of heart rate. This prototype has both visual and auditory monitors and shows EMG amplitude level and HR in the form of light and sound displayed by using LED lights and internal loudspeaker or external earphone, which are useful for biofeedback technique. At a normal operation, all system monitor uses rechargeable battery for safety from current leakage.

The accuracy and reliability of the instrument tested by using technical testing and functional testing showed that the technical testing of readout compared with the readout using digital multimeter, the average errors of EMG mean amplitude and HR were 0.17% and 0.06%, respectively. In the functional testing, external signals from function generator, ECG simulator, and ten normal subjects were recorded and compared to signal detection by using digital storage oscilloscope. The results fell within the acceptable range of controlled values. In functional testing of mental stress monitoring, comparing resting state and mental stress state of ten subjects, the results showed significantly different statistical correlation and average reading error in both EMG mean amplitude and HR. Therefore, it is evident that this gives reliable minimal allowable error. This suggests that the instrument is sufficiently reliable.