GALVANIC SKIN RESPONSE (GSR) BASED EMOTIONAL STATE EXAMINATION AND BIOFEEDBACK FOR WELL-BEING

Project Reference No.: *47S_BE_1403*

College ***:*** N.M.A.M. Institute Of Technology, Nitte
Branch ***:*** *Department of Electronics and Communication Engineering*
Guide(s) ***:*** Dr. Durga Prasad
Student(S) ***:*** Mr. Varun B. Gatti
Mr. Srajan R.
Mr. Sushan Kotian
Mr. Susheel Chetan Shetty

Keywords:

ESP32, HR, Biomedical sensor

Introduction:

In contemporary society, the pervasive nature of anxiety, characterized by a sense of worry and nervousness, has become a notable concern, especially among students grappling with exam pressures and individuals navigating job-related tensions. Persistent anxiety can lead to the development of detrimental habits such as smoking and unhealthy eating, exacerbating the risk factors associated with heart disease. The project, which centres around Galvanic Skin Response (GSR)-based emotional state examination and biofeedback for well-being, recognizes the significance of addressing anxiety through innovative technological solutions. By utilizing physiological measurements including GSR, heartbeat, and Spo2 sensors, a comprehensive system is to be created which not only detects but also manages stress effectively. These sensors act as crucial indicators, reflecting the physiological changes associated with anxiety and stress. The integration of a 1.3-inch OLED display into the system adds a layer of user-centricity, enhancing the interaction between individuals and the technology. The real-time visual feedback mechanism here, allows users to gain insights into one’s emotional states, which provides valuable information for self-awareness and proactive stress management. The project aligns with the broader trend in research and technology development, focusing on non-invasive methods for stress detection. Recognizing that stress and anxiety are linked to adverse health outcomes such as cardiovascular disease, depression, and cognitive decline, the interdisciplinary approach combines physiological sensor data with decision tree algorithms to offer a holistic solution.The endeavour not only contributes to the technological advancements in stress detection but also holds the potential to positively impact public health by informing the development of new and effective methods for managing stress and anxiety

Objectives:

- To design and implement a wearable device to monitor GSR, HR and HR of a person and to communicate the sensed information to the cloud on a periodic basis.
- To apply machine learning algorithm to detect the level of stress through the dataset of GSR, HR and SpO2
- To achieve biofeedback to manage stress through displaying images, playing music on the handheld device

Methodology:

The data is collected from the GSR and MAX30100 Pulse Oximeter Heart Rate Sensor modules using the NodeMCU. Subsequently, the sensor data is stored in a CSV file for further analysis and processing. Afterward, the stored data undergoes cleaning and preprocessing to eliminate any noise or outliers. A decision tree classifier is trained on the selected features to classify the stress level into YES or NO, followed by validating the accuracy of the classifier using various metrics such as precision, recall, and F1-score. A single bar graph, implemented using a web server, is utilized to indicate stress levels, which vary based on the metric being measured. The bar graph which is implmented using web server is used to indicate stress levels will vary based on the metric being measured. In this study, a stress detection system is devised using non-invasive and non-intrusive sensors to monitor physiological signals. A bar graph representing all three parameters is employed. This modification enhances the interpretability of stress levels for users, as stress level increases the bar graph is turned into red when the stress level is normal the bar graph is turned into blue allowing for easier analysis and appropriate action.

Conclusion:

By integrating the ESP32, GSR module, Heart Rate, and SpO2 module, it becomes possible to discern emotional states like stress. The GSR sensor gauges changes in skin electrical conductivity, indicative of emotional arousal. Simultaneously, the heart rate sensor measures pulse, and the SpO2 sensor monitors blood oxygen saturation levels, both of which can fluctuate with emotional arousal. The ESP32 processes data from these sensors to determine an individual’s emotional state. A 3D model casing for the hardware setup, which integrates the ESP32 microcontroller with sensors including the GSR module for skin conductivity measurement, Heart Rate sensor for pulse monitoring, and SpO2 module for blood oxygen saturation tracking. All sensor modules are interconnected within the casing, forming a cohesive hardware implementation for emotional state detection.The stress detection model was evaluated using a dataset of 10,000 instances, consisting of 5,000 stressed and 5,000 non-stressed dataset values. The stressed datasets were obtained from athletes and individuals who reported high levels of stress through questionnaires and assessments of physical activity The real-time sensor values are also displayed in the serial monitor, showcasing the simultaneous readings of GSR, Heart Rate, and SpO2 . Website designed to monitor real-time values of biometric signals, including heart rate, SpO2, and GSR, for an stressed individual. These sensor modules are affixed to the individual’s body and wirelessly transmit the collected data to the website. The website processes the information in real time, presenting users with the ability to monitor one's stress levels at any given moment. Following this and the user's survey submission, the website generates a personalized experience by showcasing a slideshow of relevant images and playing background music according to the user's indicated preferences. The overall objective of the interactive and personalized approach is to assist users in relaxation and stress reduction.

Scope for future work:

- The stress detection model is currently designed for the age group of 18-24 years. However, stress is a prevalent problem across all age groups, and expanding the model to cover a wider age range could be a valuable addition.
- While the current model considers several parameters for stress detection, there could be additional parameters that could improve the accuracy of the model.
- Stress manifests differently across cultures, and it is important to consider cultural differences when designing a stress detection model. Future work could explore how cultural differences can be accounted for stress detection