Intimating and monitoring Stress, Anxiety, Depression using ECG and GSR Sensors

Mohan Gowda. V  
Asst Prof, Dept of Computer Science and Engineering, GITAM School of Technology, GITAM University,  
Bangalore, Karnataka  
Sanjeev Kumar. A. N  
Asst Prof, Dept of Computer Science and Engineering, GITAM School of Technology, GITAM University,  
Bangalore, Karnataka  
Lakshmi Ramana. P  
Asst Prof, Dept of Computer Science and Engineering, GITAM School of Technology, GITAM University,  
Bangalore, Karnataka, Email: lpenukon@gitam.edu  
Sangameshwar  
Asst Prof, Dept of Computer Science and Engineering, GITAM School of Technology, GITAM University,  
Bangalore, Karnataka.

Abstract- Mental stress, depression and anxiety are the major problems of our society, as these are the cause of many health problems like hypertension, heart attack or even sudden deaths and self-annihilation. To prevent stress of a person from putting the lives of people into a danger and help to overcome the irreversible damages, as well to detect these changes in their early stages. Generally, all these problems can be detected by counseling, questioner or observing a person for a long time. But we will focus on changes that occur in human body when he/she is in stress, depression or anxiety. We used GSR and ECG components to monitor the heart beat and detect emotional while changes occurred in a person when he/she is in stress, depression or anxiety. On detecting we will send an intimation message to their family member so that they will help that person to come out of his/her situation.

Keywords: Stress, ECG Sensor, GSR sensor, Anxiety, Depression.

I. INTRODUCTION

Stress is a biochemical reaction to the social, emotional or physical lunges we face. Instant risks allow the body to "fight or flee" or rapid reaction to stress [2]. If we see a danger, a surge of tension hormones like adrenaline and cortisol occurs in our nervous system. These chemicals activate the body to take protective action. In certain instances, suggestions must be obtained to monitor this condition and in some circumstances it may become harmful. A tool to detect stress is therefore required.

We tend to generalize mental health issues, right along with trivializing them. The three are distinct with specific signs and varying severity thresholds. When you are feeling strain or nervous to notice it, and learning whether to treat it will profoundly help your emotional health, you will realize whether it is. This paper presents an approach for stress, anxiety and depression detection on people using wearable sensors with the aim of improving their quality of life and ultimately to save people from self-annihilation. The presented technique is an application of Internet of Things in embedded system.

II. RELATED WORK AND SURVEY

J. A. Healey et.al [1] they proposed the stress, anxiety and depression had been detected by using ECG and Galvanic skin response sensors separately. There are chances for missing some emotions and change in levels of depression and anxiety if we are fixed to only one type of sensors and some of the emotions can’t be perfectly found by ECG sensors/ GSR sensors. So, to get the perfect output and to judge and find each and every emotional change in the body we are combining both the sensors and only if the conditions are satisfied by both sensors outputs we will go for further actions.

Feng-Tso Sun et.al [2] in their paper he told that some experiments have been conducted in the real world. They used 5-minute intervals during the test and to distinguish between three levels of driver stress.

Soniya Lakudzod et.al [4] they have given conclusion about their project as chronic stress is endemic to modern society. Stress can be useful in hazardous conditions to keep us safe. Elective dermal behavior, HRV and respiration sensors use a logistic regression model to acquire stress-related characteristics. The GSR system given by María Viqueira Villarejo[5], which determines when an action is or is not confident with a performance rate of 90.97%. David Ellis [6] has presented an approach for stress detection using wearable physiological sensors. Their methodology is also in a position to evaluate the status of the issue and agree on its tension condition. Diagnosis findings indicate that we are a strong starting point for the detection and care of individuals in the real time of their emotional state in order to enhance their quality of life.
The above existing methods were either only with ECG or GSR sensor and few based on ECG to detect stress, GSR for detecting depression. In the paper it was carried out using wearable physiological sensors. In another paper they have performed the tests on the person’s blood pressure and the stress levels. Our proposed system eliminates the heavy cost, and it monitors heart rate in mobile App and using wearable sensors it helps in detecting stress, anxiety and depression and intimates about it via a SMS. Table.2 below gives the detailed information about the literature survey we have done.

Table.2 Literature survey

<table>
<thead>
<tr>
<th>Author</th>
<th>Methods</th>
<th>Remarks/Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlee Frenandes et.al</td>
<td>Determination of stress using blood pressure and GSR sensor</td>
<td>The results were that the higher GSR levels were due to exercises also.</td>
</tr>
<tr>
<td>Sriramprakash .S et.al</td>
<td>How to select dominant features and fuse overlapping technique to extract features from sensors.</td>
<td>A hardware model for stress detector can be realized with the chosen features.</td>
</tr>
<tr>
<td>Yisi Liu et.al</td>
<td>EEG based Stress Monitoring</td>
<td>Designed an experiment to induce 4 levels of stress.</td>
</tr>
<tr>
<td>Sunjoo Hong et.al</td>
<td>Depression Monitoring System with Heart-rate Variability</td>
<td>A monitoring system is proposed for mental stress analysis.</td>
</tr>
<tr>
<td>Nicos et.al</td>
<td>ECG Analysis Using Nonlinear PCA Neural Networks for Ischemia Detection</td>
<td>Studied the representation power of NCPA for the description of cardiac beats.</td>
</tr>
<tr>
<td>Nutan D Ahuja et.al</td>
<td>GSR and HRV: Its Application in Clinical Diagnosis</td>
<td>This was on the application of GSR and HRV in diagnosis of emotion change and determine the personality.</td>
</tr>
</tbody>
</table>

I. III. SYSTEM DESIGN

The system makes use of Arduino Technology as the central component that is plugged together with all the other modules of the system. The other components are ECG, GSR Sensors, Bluetooth, App for monitoring heart rate via ECG, LCD, GSM for the SMS technology. Fig.1 shows the data flow of our project.

The project device is turned ON by providing in the input as the power supply then all the modules in the project start blinking indicating that the modules are in proper working condition. When the system is started then and intimation SMS is sent as system starts to indicate that the device is turned ON.

The ECG is placed with the help of three strips that are placed onto the right hand, left hand and right leg and the readings are taken and displayed on the LCD screen and as well it sends to the bluetooth module so the data is transferred to the mobile app to plot the graph to monitor the heart rate and when the GSR is placed on to a finger with the help of the skin conductance we can intimate about the conditions of stress, anxiety and depression.
Certain threshold values are provided in the code where, when the GSR sensor will meet those respective thresholds, indicating that if the person is undergoing stress or anxiety or depression and an intimation message is sent via the GSM module to the person's family member or a close friend so that they could help that person to overcome from the stress/anxiety and depression state.

When the stress/anxiety/depression threshold values are met, then an intimation message indicating that the person is feeling stressed or the person is feeling anxious or the person is feeling depressed that respective message is sent as an SMS text via the GSM module to the saved contacts so that it would help the person to recover from the state which they are.

IV. IMPLEMENTATION AND OBSERVATION

The heart beat rate monitoring and sending that data via bluetooth module to a mobile app to plot a graph and for self-monitoring purpose, the stress, anxiety, depression states where taking data form GSR and ECG components. These data’s will be monitored through the application which is written in C and embedded C packages and functions in aurdino board.

The following Fig.2 is the Architectural Wiring diagram of our system:

Figure.2, Architectural Wiring diagram

Table .2 Testing of the project device as a whole

<table>
<thead>
<tr>
<th>Test case description</th>
<th>I/P given</th>
<th>Expected Result</th>
<th>Actual Result</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>When device is ON</td>
<td>Power is supplied to ON the device</td>
<td>LCD should display SYSTEM STARTS, send SMS, devices must blink</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>GSM initialization</td>
<td>When device is ON</td>
<td>LCD displays GSM initialized</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>Bluetooth HC-05</td>
<td>Power is supplied to ON</td>
<td>Starts to blink</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>Working</td>
<td>the device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Pairing of Bluetooth HC-05 with mobile App</td>
<td>ON mobile Bluetooth</td>
<td>Display HC-05 as a device to be paired with mobile</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>ECG Working</td>
<td>Power is supplied to ON the device</td>
<td>Starts to blink</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>ECG placed onto person</td>
<td>Three strips placed on persons hands and leg</td>
<td>Displays the readings on LCD and graph on App</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>ECG not placed onto a person</td>
<td>Three strips not placed on persons hands and leg</td>
<td>No graph is plotted on App</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>GSR to detect stress</td>
<td>Given a threshold value</td>
<td>When threshold met display STRESSED</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>GSR to detect anxiety</td>
<td>Given a threshold value</td>
<td>When threshold met display ANXIETY</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
<tr>
<td>GSR to detect depression</td>
<td>Given a threshold value</td>
<td>When threshold met display DEPRESSED</td>
<td>As Expected</td>
<td>Successful</td>
</tr>
</tbody>
</table>

When the Bluetooth module is turned ON by providing the input as a power supply making the device to be turned ON, the result expected is it has to start blinking and as expected it starts the blinking. The above table.2 tells us how actually the testing of our project went on. First of all, we need to pair this HC-05 module to the mobile so that we could connect the devices and then can display the graph in an App on mobile phone.

The Bluetooth module and the mobile has to be paired via the Bluetooth connection so the Bluetooth module should be available to the mobile devices to recognize to get connected and paired up. To display the graph, the ECG signal will be sending via Bluetooth to plot graph in the App. Whenever the ECG signal is updating the values it should show in that, it's waiting for the input and when the ECG signal is not connected then no graph has to be plotted. When the ECG is turned ON providing input as a power supplied, it should start blinking. Then the ECG when it's placed on to the person with the help of the three strips on to both the hands and then a leg it should display the ECG readings on the LCD and plot a graph on the App.

When ECG is not placed on to the person that means when the strips are not placed on to the person no graph has to be plotted indicating that it is not connected/placed onto the person. GSR sensor to detect the stress, anxiety and depression levels. Certain threshold values are provided in the code and when these respective threshold values are to be met if the person is that states. GSM module, the input provided here is the power supply to turn on the device. When the system is turned on system starts message has to be sent and when the respective threshold are met for the stress or anxiety or depression, respective messages has to be sent to the saved contact of the persons family member or the close friend and as well display these on the LCD.

V. Results

A screenshot, or screen capture, is a picture taken of computer’s desktop. This may include the desktop background, icons of file and folders, and open window. The project executed successfully for the given set of possible inputs. Bellow Fig.3 and Fig.4 is about pairing up of bluetooth device with mobile via an App.
The ECG device sends its data via a bluetooth module called HC-05 so that a graph can be plotted to monitor the heart rate. When the device id turned ON the HC-05 module is ON and then you need to turn ON the bluetooth in your mobile to get connected.

The HC-05 device will be available to be paired with your mobile so click on connect. The device gets paired up and will start plotting the graph. Screenshots of stress, anxiety and depression intimation messages received to the mobile via GSM when the threshold values are met.

The below figures 5, 6 and 7 are the text messages received to the mobile via GSM module when the person is under stress, anxiety and depression.
Figure 5, SMS received when the person is under stress

Figure 6, SMS received when the person is in anxiety
VI. CONCLUSION

In this project we proposed a multi-modal system that combines ECG, and GSR sensors for intimating and monitoring the stress, anxiety and depression levels of a person. We used the ECG for monitoring the heart rate of the person by displaying the value on the LCD and as well sending this data via Bluetooth module to an app to plot the ECG graph on the mobile phone. The GSR sensor is placed on to the finger and it works on the skin conductance i.e. based on the sweat secretions and with the help of certain threshold values. When these thresholds are met an intimation message in the form of text SMS is sent to the saved contact details of that person’s family or close friend intimating about their state so that they will help them to overcome from it, and also on the LCD display these states i.e. stressed/anxious/depressed id displayed if the person is in that state.

REFERENCES


