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Monitoring and Intimating Stress, Anxiety, Depression using ECG and GSR Sensor

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ABSTRACT

The pre-eminent issue for an ambient assisted living solution is automatically monitoring and intimating the anxiety, stress and depression. The crucial obstacles of our society are anxiety, depression and mental stress as these lead to innumerable health issues like sudden deaths, heart attack, hypertension and self-extermination. It is inevitable to dredge in its initial stage to preclude stress from becoming dreadful and inducing irrevocable damages. Generally by counseling, questionnaires, or by keen observation of a person from a long time helps us to detect whether he is stressed or not. But in this paper we focus on changes that prevail in the human body when a person is in depression/anxiety or stress. We will supervise the heart beat and ascertain emotional changes that transpire in a person when a person is in stress, depression/anxiety. On diagnosing we will send a message to their family members or counselor so that they can help them to come out of their situation. This paper enfolds sporadic classes of sensors, using proximity less methods as well as proximity for human emotion detection.

Key words: Anxiety, Depression, ECG, Human emotion, Stress

1. INTRODUCTION

With the evolution of industry and the swift escalation in the ply of quick-witted technologies in fellowship, the want for technologies to gauge the demands of a prospect customer and hand-pick the extra pertinent solution for them is expanding fiercely.

Automated emotion evaluation (AEE) is noteworthy in locality such as: expert systems, retailing, education, and the entertainment industry [1]. The solicitation of AEE is worn to attain diverse grails:

(i) In expert systems: layout quick-witted synergic or amenity robots which can negotiate with humans;

(ii) In retailing: initiate peculiar imply, based on the psychological state of the probable patron;

(iii) In education: used for revamping schooling affairs, comprehension handover, and intuition methodologies;

(iv) In entertainment industries: to propound the customarily expedient entertainment for the earmark spectators.

People can make use of wearable sensors with the final aspiration of revamping their supremacy of life and essentially to save people from self-extermination is the goal of our project which includes an embedded system as an application of the internet of things. Any genre of demand may be bad or good incidents our body responds via stress or depression or anxiety. When people are stressed their bodies retaliate by freeing chemicals into the blood. All calibers of psychological and physical ailments take place when a person predisposes to too much stress. Stress can lead the way to high cholesterol, heart attack, thyroid problems, low blood sugar etc. Impaired sexual performance, abdominal pains, headaches, dizzy spells, insomnia, tiredness, heavy breathing, fatigue, sweating, distraction are the most typical signs of anxiety. Another occurrence of stress is psychological disorders and phobias. The various levels of anxiety are:

1. Myocardial Infarction (Hyper Acute Stress)
2. Type A - Acute stress
3. Ischemia - Hyper Chronic stress
4. Type B - Chronic Stress

1.1 Stress

People always achieve under pressure and strive to do our best under stress. Our body and mind suffer when you are relentlessly running in emergency mode. The most recurrent kind of stress is acute stress. Whenever there is a novel challenge, happening or a demand it enkindle our fight-or-flight retaliation. The persuasion of a close call vehicle mishap, a wrangle with a family member or a grievous flaw at profession sink in, our body turns on this biotic retaliation. When you ride a roller-coaster or when an individual jumps at you in the possessed house you experience acute stress. In factuality, they brawn literally be healthy for you, as these stressful situations give your body and brain custom in evolving the best retaliation to here after stressful locales dire acute stress such as stress suffered as the casualty of a crime or life-terrifying case can result to mental health issues, such as post-traumatic stress disorder or acute stress disorder.

When acute stress come about persistently it is known as episodic acute stress. Mankind who incline to see the negative aspect of everything or are pessimistic or worry warts, short-tempered, irritated and anxious are the ones who

suffer with episodic acute stress. These kinds of people acknowledge stress as part of their life and are burdensome to change their lifestyle.

If acute stress is not reconciled and unfolds to escalate for a long stretch of time it results in chronic stress. The main convictions are: unemployment, unhappy marriage, a deteriorated family and poverty. It leads to many health perils such as heart ailment, lung ailment, mishaps, cancer, suicide and cirrhosis of the liver.

1.2 Anxiety

The existent event has passed but you still feel stressed is known as anxiety. Anxiety is nothing but even though the stimulus does not prevail anymore and there is an ever-lasting feeling of being stressed. Constant daily uneasiness, unease or nervousness, fearful feeling in the chest or stomach when people are placed in an embarrassing situation when returning from the offending event all these feelings just whisk under the surface and manifest themselves leading to anxiety. The ongoing stressed feelings such as bullies, job pressures, fake friendships, and worry about losing our loved ones are examples of anxiety. On observing social anxiety is the one which is on rise.

General anxiety disorder:

For a period of six months or more if a person worries about different things is the symptom of this disorder.

Social anxiety:

A person who has fear of speaking in public, eating in public, being decisive at work or small talk have a profound fear of being reprehensible, humiliated or embarrassed.

Specific phobias:

A person may go to any extent to avoid a particular incident such as travelling in a plane or having an injection. There are many kinds of phobia.

Panic disorder:

Dizziness, excessive perspiration, pain in chest, breath shortness are something which is experienced by a person who is having a panic attack. Panic attacks are ordinarily uncontrollable feelings of anxiety combined with a range of physical symptoms which are intense. If a person has panic attacks recurrently or fear having more than a month then they are said to have panic attacks.

Obsessive compulsive disorder:

Mankind try to alleviate their apprehension by conveying out certain rituals or conducts, although they may acknowledge it as silly such as constantly washing their hands due to fear of germs and contamination.

Post-traumatic stress disorder (PTSD):

When a person experiences a war, disaster, accident, assault they tend to have this disorder. Flashbacks of events, upsetting dreams, avoiding anything related to this event and difficulty in relaxing are some of the traits of this disorder.

1.3 Depression

People who have feelings such as moody, sad or being down from time to time for longer periods of time, weeks, months and even years. People tend to hide their depression, due to the stigma attached. The most common mental illnesses we have in society today and it has been estimated that around one in five people will go through it in their stage of life. Mild, moderate and severe are the terms in which depression are classified.

1.4 Are these three strands same in men and women?

No, these strands differ in men and women. Same device is required to ascertain the levels and to help in overcoming them.

Hormones called cortisol and epinephrine together inflate a mankind's blood pressure and circulating blood sugar level and the efficacy of the immune system gets lower by cortisol alone[16].

Stress

In Women: pressure, frustration, hormonal changes. In their efforts to get enough sleep only 33 percent of women are being successful.

In Men: Smoking, alcohol consumption, drugs, worry, job dissatisfaction, restless anxiety etc. In their efforts to get enough sleep only 25 percent of men are being successful. Men fail to recognize that they tend to take more stress than women.

Anxiety

In women: in women anxiety disorder occurs earlier than in men. Women have numerous psychiatric disorders during their lifetime than men the time a girl reaches puberty to the age of 50, women are likely to have anxiety twice than in men.

In men: Heart pounding, excess sweat, emotional signs, men tend to ignore these kinds of support because they think they're supposed to be tough.

Depression

In women: women play many life roles. All these changes are due to the ups and downs throughout life. Some of these changes may be due to life events which affect her work, sleep and eat in effective and normal matters.

In men: men tend to overreact, think clouded and overwhelmed which fuels negative thoughts and further affects his ability to manage stress, causing a downward spiral.

2. LITERATURE SURVEY

The innumerable analysis and research made in the discipline of your preference and the results already published, taking into account varied parameters and to extend in this particular field is nothing but literature survey or literature review. Stress, depression and anxiety had been detected by J.A.Healeyet.al[2] using Galvanic skin sensors and ECG separately. If we are using only one type of sensor there may be unknowingly missing some emotions and changes in the level of depression or anxiety. ECG sensors/GSR sensors cannot find some emotions perfectly. To find each and every emotional change in the body and to get the perfect output we are going to combine both sensors and if conditions are satisfied by the sensor's output we will go with further steps.

In the real world some experiments are being conducted as described in the paper Feng-Tso Sun et.al [3]. By keeping track of various corporal signals GSR, ECG, ElectroMyoGram (EMG), and respiration in a pre-scheduled path setting, Healey and Picard computed drivers' stress rejoinder. To discern betwixt three extent of driver stress they worn 5 minute interim of data during rest, city driving conditions and rest. Heart rate and skin conduction imparted

the giant all-inclusive tie-in with drivers' stress magnitude over numerous drivers and driving days, outstretching an precision of over 97%.

Based on SHIMMERTM platform GSR and ECG signals were procured using two different synchronized modules was experimented by Giulia Crifaci et.al [4], its a technology which is connected or disconnected facilitates a standard features of low consumption and great competency of storage based on wireless communication technologies. CNR of Pervasive Healthcare Laboratory of the Institute of Clinical Physiology remodeled the ECG SHIMMERTM based platform using signals of a wearable sensing set. To amortize the numeral of antiquity and a defenseless Bluetooth communication protocol for data transferrable, electronic boards include signal conditioning. For physiological sensing enactments light-mass (~100 g) and condense forms are more preferable. A light-mass strap which is wholly washable and guaranteed for flawless congenial contiguity which adapts itself to the body formation can be used as a wearable device. The voltaic board comprehends a piece of preconditioning of the signal with a contemporary expenditure of 60 μA and frequency range of DC-15.9 Hz; lower than the form used for the ECG.

For mental stress analysis, a wireless wearable keep track of process was proposed by TaehwanRoh et.al [5]. The degree of depression can be reckoned through the physiological signals using the self-report inventory BDI. In 3.7V electrically powered battery, the process works incessantly for more than 10 hours. With low power consumption the solicitation peculiar SoC can prevail the traits on HRV faster because most of perplexed signal probe functions are enacted on the silicon hardware. 71% is the average fidelity of the codification measured. The P-FCB comprehends a 5mm thickness process and serves flexible and bondable electrodes in itself. Finally, the traits collected from the system are disseminating to android-based smartphones via Bluetooth connectivity for commodious user feedback.

For keeping we alert about the dangerous situations stress can be gainful. Security, entertainment, medical and commercial are some of the applications of wearable sensors. chronic stress is endemic to modern society, SoniyaLakudzod et.al [6] has proposed a conclusion in this project. Restrain of the immune system, increase blood pressure, infertility, diabetes, damage to muscle tissue are some of the damages caused to the body due to long duration of stress. Rate of breathing, increase in body temperature, skin conductance level and variability in the heart rate are used for calculating stress level.

Using HRV, respiration sensors and elect dermal activity are used to obtain the stress related features. Delineation competency of NCPA for the elucidation of heart beats have been studied by Telemachos Stamkopoulos et.al [7] in their work. Pedagogy is browned for one and all patient on one's own, so a routine is delineate to toil on a file-to-file basis. They have also trailed the algorithm using one, three, and four principal integrants. When only one integrant was used, the results were considerably inferior. When three or four integrants were worn, the pedagogy time and the computational intricacy aggravated without considerable upgrade of the upshots collated with those obtained using two principal integrants.

Inquisition of loftier coherent obligations, mental predicament and imitation of affect are extensively worn for EEG projects by GiorgosGiannakakis et.al [9] Using EEG there is not ample literature as stress/anxiety are contemplated composite ardours. It is affirmed that EEG retaliation to efficacious valence stimuli is left frontal activity while dismissive valence stimuli cause inflation to right venture. To distinguish between states mainly between inter hemispheric locations than intra-hemispheric he worn coherence analysis. During univariate statistical analysis the parameters did not show differences, both mobility and robust procedure was combined in the data subset. In Spite of some differences in the in channels band powers did not capitulate any obvious pattern. Before and after effectuating the broached activities respectively, Atlee Fernandes [10] famed stress and blood pressure pitch of participants. To ascertain whether the volunteer is one and the other cognitively or corporeal stressed or has accustomed ambience, these graphs were enumerated together to conclude.

If the volunteer has a stunted BP along with stunted stress, it was sealed to be habitual. But if the stress pitch is high, and BP remains the same, the volunteer is interpreted to have cognitive stress whose extremity depends on the pitch of stress. But if the BP is noted to be high, then it was concluded as physical stress. Before working any physical activity, if volunteer GSR value is high then it can be categorized as mental stress. Identically if BP value does not rise after physical task then it is normal condition. It is not associated with mental stress if GSR values increase after the exercise, hence it is concluded.

Working with GSR device MaríaViqueiraVillarejo [11] ascertain there is a different situation or an effort from actualitylazed with 90.97% triumph rate. The adjacent aim is to delineation a contrivance to get going in series to set the portal betwixtin compatible psychiclocale.Corporeal waves such as SCL, HR, and facial EMG can dredge a personage's strain extent, but a piece corporall sensor has its fragility as said by Riccardo Sioni [12]. In order to outstretch this goal people should not hesitate to use sensors in this object. Apple watch and Samsung Gear S users measure HR and EDA in real time to track the fitness activity, in future more sophisticated devices can be worn to to detect the stress and accuracy of emotions. The evolution and summing up of self-activating stress-detection systems have a critical impact on issues intrinsic to human physiology. For single emotion only few physiological signals are related for exemplar, whilst EDA can be securely assessed a correlate of corporeal arousal, cardiovascular and respiratory systems are determined by both SNS and ANS activity. Thus, it is entangled to plot a corporeal assessing system that makes use of these waves to proffer self-activating trauma detection with unwavering fidelity. Wave artifacts caused by user movements vigor expedites prune such fidelity or even restrain real-time trauma detection. People can be strained for divergent apologia: for example, trauma in a user navigating a VE can be evoked by a break down controller, a

burden some pitch, or an surge in room temperature as well as by audio visual stimuli.

IoT authorizes user to communicate and control smart objects to extricate information that is necessary. Enormous quantities of data will be created and swap which in turn help in making decisions [15].

3. IMPLEMENTATION

Enactmentjuncture of the gauge puts the gauge into action. Enactment is the cognizance of an application, or accomplishment of a plan, specification, algorithm or policy, idea, model, design, specification. Before the enactment of a gauge, the implementers (spearheaded by the gauge committee or executive) should pin point their strengths and infirmity (internal forces), opportunities and threats (external forces).

3.1 Language Specification

For programming the embedded systems, the embedded programmers use the most desired language is Embedded C. Assembly, BASIC, C++ are other programming languages which can be worn for prosper embedded systems but embedded C remains favored due to its competence, portability and barely development time.

3.2 Libraries worn

Liquid Crystal Library - Based on Hitachi HD44780 (or a compatible) chipset, arduino board controls Liquid Crystal unveils(LCDs) using this library which is available on ultimate text hinge LCDs. The library works in either 4- or 8-bit mode.

Exemplar:

Autoscroll: Shift text upright and upleft.

Blink: Mastery of the block-style cursor.

Cursor: Dominance of the underscore-style cursor.

Unveil: Quickly vacuous the unveils without losing what's on it.

Hello World: Unveils "hello world!" and the seconds since reset.

Scroll: Scroll text upleft and upright.

SequentUnveil: Tackles sequent input, unveils it.

Set Cursor: Set the cursor position.

Text Direction: Dominance which way text flows from the cursor.

Software Sequent Library

The Arduino apparatus has built-in assist for sequent communication on pins 0 and 1 (which also goes to the computer via the USB connection). A UART, the native sequent reinforce happens via a piece of hardware (built into the chip). Even while working on extra tasks this apparatus lets the at mega chip to receive sequent communication, as long as there is a sequent buffer of 64 byte. To allow sequent communication on other digital pins of the Arduino, the software sequent library has been developed, to replicate the functionality using this software. It can have multiple sequent ports with speeds upto 115200 bps. A criterion accredits inverted waving for devices which vital that protocol. The genre of Software Sequent embraced in 1.0 and later is hinged on the NewSoft Sequent library by Mikal Hart.

3.3 Architectural Wiring diagram

Architectonics wiring illustrations manifest the lighting, kinships of receptacles, locations and eternal electrical amenities in a building. Kinshiping wire routes may be manifest approximately, where precise receptacles or fixtures must be on a common circuit. Below is the Fig. which tells how the wiring diagram looks like in our project.

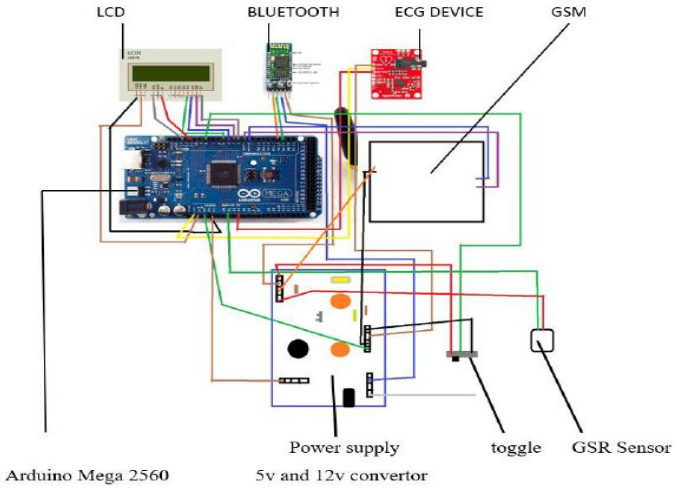

Figure 1: Architectural Wiring diagram

4. EXPERIMENTAL RESULTS

An illustration taken from a computer's desktop is known as screen capture or screenshot. This may embrace the desktop background, icons of file and folders, and open window. It may also encompass whatever is being unveiled by forthwith running programs. The project executed successfully for the given set of possible inputs. Pairing up of Bluetooth device with mobile via an App

Figure 2.1: HC-05 available for pairing

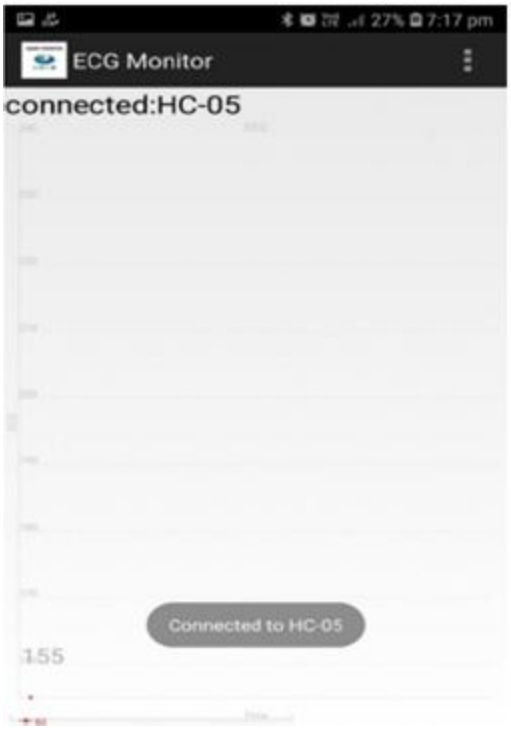

Figure 2.2 : After the HC-05 is paired with mobile

The figures 2.1 and 2.2 shows how the pairing is to be done with the HC-05 and mobile app. 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-05module 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.

Whenever the person is under stress or anxiety or depression an intimation message is sent to the family member or friend so that they can come out of their state. The below three figures are the text messages received to the mobile via GSM module when the person is under stress, anxiety and depression.

Below figures 2.3, 2.4and 2.5 shows the messages received by the care taker/ say family member/ friend whenthe respective thresholds are met.

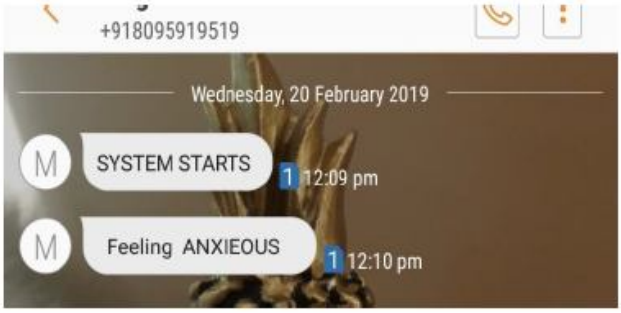

Figure 2.3: SMS recived when the person is under stress

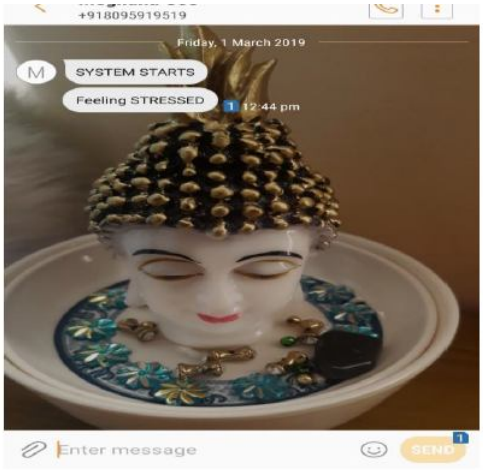

Figure 2.4: SMS received when the person is in anxiety

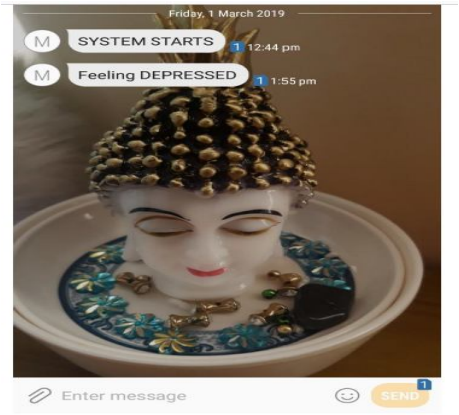

Figure 2.5: SMS received when the person is depressed

5. CONCLUSION

This project proposes a multi-modal structure that amalgamates ECG, and GSR sensors for intimating and monitoring the stress, anxiety and depression levels of a person. Haveworn the ECG for monitoring the heart rate of the person by unveiling 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 unveil these states i.e. stressed /anxious/depressed is unveiled if the person is in that state.

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