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EMOTIONS MONITORING SYSTEM

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***Abstract*—The aim of this paper is to develop an emotions monitoring system. That can be used by a person to track his or her mental state. It can be used for improving the mental health of a person. People will be able to identify what is causing them stress, and they will be able to find solutions to relieve it using this system. This device monitors the emotions of a person based on the electrical conductivity of the skin. This device measures the pulse rate and Galvanic Skin Response (GSR) value and determines the emotion of the person. When there is an emotional arousal then the electrical conductivity of the body changes because of the sweat. The electrical conductivity can increase or decrease based on the kind of activity. Changes can be seen in the pulse value of the body also simultaneously. The Galvanic Skin Response (GSR) and Pulse Rate Sensor readings are processed by the Arduino Uno. The GSM module is coupled to an Arduino, which sends a notice to the person's registered mobile phone about his or her mental health. It can be used by doctors to observe the patients undergoing surgeries etc. It can also be used as a personal care device.**

***Keywords*—Stress, Emotions, Galvanic Skin Response (GSR), Global System for Mobile Communication (GSM), Arduino (Microcontroller), Pulse Rate.**

I. INTRODUCTION

In today's society stress and anxiety problems are very much common. Not only adults but teenagers nowadays are also depressed. Your body's response to any form of demand or threat is stress. The body's defences kick into high gear when it detects threat, whether real or imagined, in a quick, instinctive process known as the "fight-or-flight" reaction or the "stress response" [1].

A human can go through many health issues that are related to stress. Stress can cause or exacerbate a variety of health issues, including depression and anxiety, pain of any type, sleep disorders, autoimmune disorders, digestive disorders, skin illnesses such as eczema, heart disease, weight concerns, reproductive concerns, and cognitive and memory impairments are just some of the concerns that people face [2].

Stress management can be hard and perplexing since there are so many various types of stress - strong episodic depression, chronic stress, and acute depression [3]. It is the result of current pressures and demands, as well as future targeted needs and excessive job stress. The majority of us face big stressful events on a daily basis.

Emotion is vital in many aspects of our lives, including rational thinking, decision-making, and so on. We may be able to manage it, but we have no way of knowing what effect it will have. When you are not paying attention to your emotions, you may be able to dismiss them, but if they overwhelm you, you will lose control. Physiological sensors have been able to assess physiological signals in recent years due to rapid advancements in hardware and signal processing approaches. We will be able to create and deploy a mobile personal emotion monitoring system by further investigating the relationship between physiological data and emotions. This system is intended to be mobile, gathering personal physiological data via wireless sensor networks in order to identify emotion status and, if necessary, to provide a warning for unhealthy feelings [4].

Our aim here is to provide a low cost and portable system that helps people monitor their mental state. It also keeps a track of mental state by regularly notifying the person via a text message on his or her mobile.

II. RELATED WORK

The body's response to stress through physical, psychological, and emotional responses, stress can be identified by a range of symptoms such as ingestion, according to WebMD [5]. Begum, Funk, and Xiong[6] employed physiological measures including Heart Rate Variability (HRV) and finger temperature (FT) to assess stress levels, combining Zadeh's[7] fuzzy logic with Andren and Funk's[8] case-based reasoning technique. Begum, Ahmed, Funk, Xiong, and Schéele [9] obtained data from sensors between both stress and free conditions. However, in the Qis [10] study, mouse compression signals were collected from studies that filled web forms with usability issues.

Sierra, Avila, and del Pozo [11] conducted a thorough examination and comparison of the aforementioned methods, concluding that fuzzy logic is the best algorithm for stress detection. They employed a Sugeno fuzzy logic technique and two physiological signals, GSR and HR, to create a stress detection system. They hit the accuracy of 99.5% while detecting the stress of 80 subjects. Sierra et al. [11] suggested fuzzy logic as a decision method, which included crisp algorithms from Begum [12], Healey and Picard [13], and Sarkar's algorithm. Stress was detected with a 99.5 percent accuracy using a Sugeno fuzzy logic system and the extraction of templates. Instead of employing hyperventilation as a stress inducer, a new stress inducer was examined in this study, one that is associated with computer use.

Keeping with this theme, the research presented in [14], [15] offers a system that collects FT, GSR, and blood volume pulses (BVP). The primary feature of this system is that it acquires data

in a nonintrusive manner, and that the prior physiological indications have a predictable relationship with stress fluctuation.

Lisetti and Nasoz's research [16] gives a comprehensive examination of emotion recognition, including a thorough analysis of the literature on the experiments conducted to elicit emotions, taking into account demographics, algorithms, techniques, and so on.

III. MATERIALS & METHOD

In this system we have used 1 - Galvanic Skin Response Sensor (GSR), 1 - Pulse Rate Sensor, 1 - Microcontroller i.e. Arduino Uno, 1 - LCD, and 1 - GSM Module.

A. Hardware:

GSR Sensor:
We use a GSR sensor to track sweat gland activity, which is linked to emotional arousal.

Pulse Rate Sensor:
Pulse waves, or changes in the volume of a blood artery caused by the heart pumping blood, are measured by an optical heart rate sensor. An optical sensor and a green LED are used to detect pulse waves by monitoring volume changes.

Arduino Uno:
It's a microcontroller board that's open-source. It is based on the ATmega328P microprocessor from Microchip. It controls the functions of all the devices attached to it.

LCD:
There are two lines, each of which may display 16 characters. This LCD uses a 5x7 pixel matrix to show each character.

GSM Module:
A GSM module, which is also known as a GSM modem. It is used for establishing the connection to a remote network using the GSM mobile communication technology. They are, in essence, equivalent to that of a typical mobile phone is in the eye of a cell phone, on the net, as long as the need to use a SIM card itself is determined by the network.

B. Software:

We have used the Arduino Integrated Development Environment (IDE) for writing the arduino code. The language used to code the arduino is C++.

The General Public License License, version 2 applies to the IDE's source code [17]. The Arduino IDE has specific code structuring guidelines to support the languages C and C++ [18]. The Wiring project is a software library that is included with the Arduino IDE and provides numerous common input and output processes. User-written code just needs two basic functions to start the sketch and the main programme loop, which are compiled and linked into an executable cyclic executive programme with the GNU toolchain, which is also included with the IDE release [19].

C. Methodology:

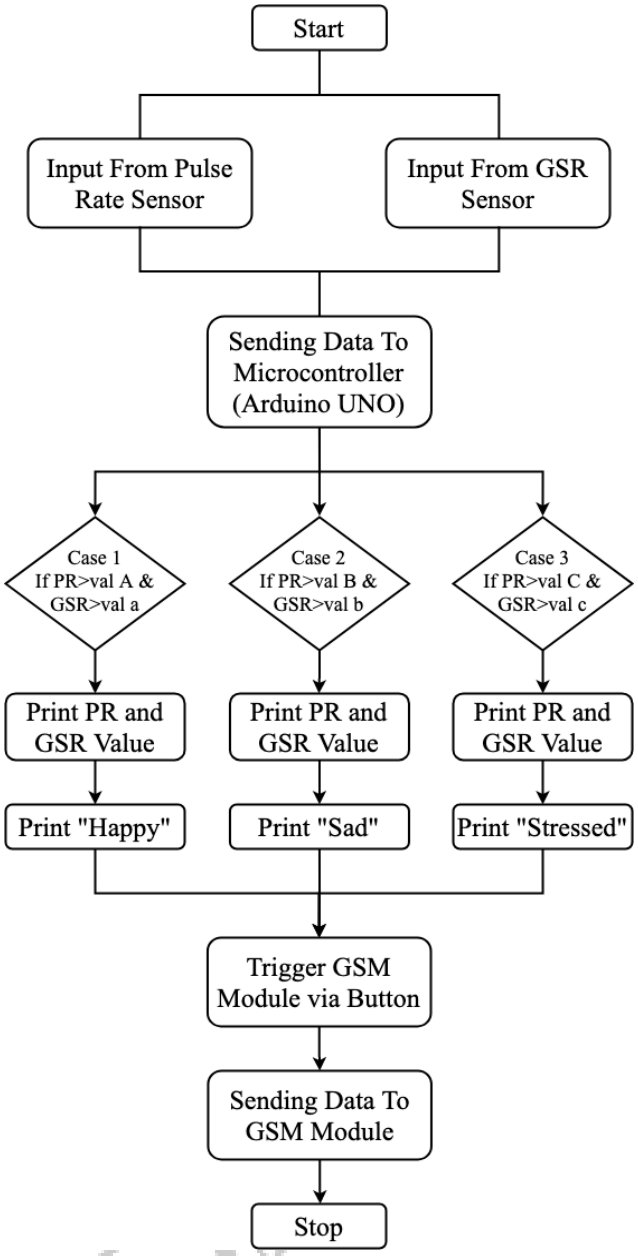

Fig. 1: Flow Chart

The flow chart In fig. 1 is the representation of how the whole system works.

But first need to perform a prerequisite of this i.e. to get the values of the GSR sensor and the pulse rate sensor of that person at his different levels of emotions. These values will be used when the system is in the working stage. On the basis of these values only we will set the emotions. Now, for recording these values we need to conduct an emotions experiment.

In this experiment we can make a person do different kinds of physical activities like walking or running and then measure his or her GSR and pulse values. We can give them some mental tasks. Also we can ask them to fill out a survey [20]. The survey will contain questions regarding their life. Basically questions related to their stressful moments and happy life. By making them remember their stressful days we can trigger their emotion and get GSR and Pulse Rate values. Then we can compile all the results and assign the values to the variables, and then the result will be accurate.

The first step as shown is getting the values of GSR Sensor and Pulse Rate sensor. So to get the value of a GSR sensor. The two electrodes of the GSR sensor are required to be connected to the fingers of the person. One electrode is connected to the middle finger and the other electrode is connected to the thumb. At the same time the index finger needs to be placed on the Pulse Rate Sensor to get the pulse rate of the person. In the second step the data of the GSR sensor and the pulse rate sensor to the microcontroller that is our Arduino Uno.

Now in the third step, the data is processed by the arduino. In this section we have created three different cases to detect the mental state of a person.

In case 1, if the pulse rate sensor value is greater than val A and the value of GSR sensor is greater than val a, this means that the emotion of that person is happy. In case 2, if the pulse rate sensor value is greater than val B and the value of GSR sensor is greater than val b, this means that the emotion of that person is sad. In case 3, if the pulse rate sensor value is greater than val C and the value of GSR sensor is greater than val c, this means that the emotion of that person is depressed. (val A, val B, val C, val a, val b, val c are the values that we need to feed the system). Then values of GSR and pulse rate sensors are displayed on the LCD and then the emotion is also displayed on the LCD.

In the fourth step, we trigger the GSM module by pressing a button. The data of the GSR sensor and the pulse rate sensor is sent to the GSM module. Then the GSM module sends a text message on the registered mobile number of the user about his or her mental state.

By this we can keep track of our mental state everyday just by using this device.

IV. RESULTS AND DISCUSSION

In Fig 2, the product prototype can be seen.

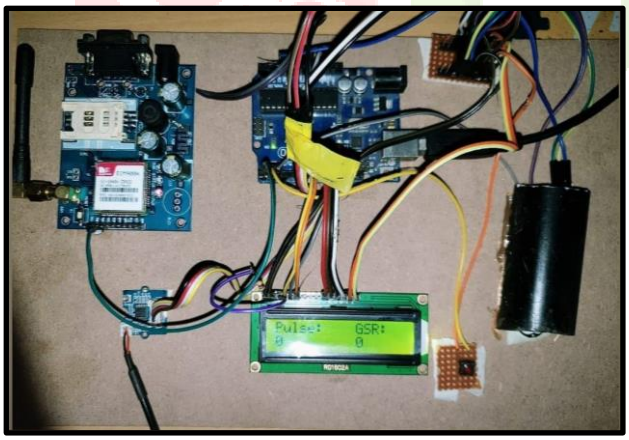

Fig. 2: The Prototype

This prototype is completely in working state. It was tested on multiple subjects and the results were quite good. Here, the pulse rate sensor is covered with a black piece of card to improve the efficiency of the pulse rate sensor.

In Fig 3 and Fig 4, the values of the Pulse Rate sensor and GSR sensor can be seen before and after doing physical exercise (20 push ups).

Fig. 3: Values of the Pulse Rate sensor and GSR sensor

Here in Fig 3, it can be clearly seen that the value of the pulse is 72 i.e. normal and GSR value is 3180 i.e. normal emotion. The electrical conductivity of the body is low because no sweat glands were active at this moment. By Fig 3 we can suggest that the mental state of the subject is normal. Higher the value of GSR, the happier the subject is.

Fig. 4: Values of the Pulse Rate sensor and GSR sensor

In Fig 4, it can be seen that the pulse value has risen to 86 from 72 and GSR value has decreased to 2520 from 3180. This shows that the electrical conductivity of the body is increased. That means that sweat glands were active. And the pulse rate is also high which means some kind of activity is done by the subject.

In the Fig 5. the message sent by the GSM module can be seen. The GSM module sent a text message on the mobile number of the user.

Fig. 5: GSM Output On Mobile Text Message

In the above image the test message has been sent to the subject on his registered mobile number via GSM module. The pulse here is the pulse rate and the human resistance here is the GSR value of the subject. We have connected a button to the system that triggers the GSM module to send the message to the subject.

V. CONCLUSION

It is verified that we can easily monitor our mental state using the GSR and Pulse Rate sensors. It is not especially for detecting just stress because when the subject is working out, the values of GSR and Pulse Rate sensors might be very close to the values of GSR and Pulse Rate sensors when the subject is stressed. So to overcome that drawback we will require the user to input the kind of activity he was doing. If AI is applied to it then it would be even more efficient.

VI. FUTURE SCOPE

In the future, we aim to use artificial intelligence to detect emotion. We can ask the user to enter the type of activity the user was doing and by getting the values of the GSR sensor and Pulse Rate sensor, the AI algorithm will give us the mental state of the user. Also by converting this system in the form of a wristband it would be even easier to carry and you can keep a track of all kinds of activity all the time. Also it can help doctors in monitoring the patients remotely as the data can be transferred to the doctors also.

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