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Human Stress Level Detection and Monitoring System

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ABSTRACT

Stress is an inevitable part of life, but when it gets out of hand, it may lead to problems like impaired focus, anxiety, depression, and drug misuse, among other mental health difficulties. When and what causes stress, the majority of individuals have no idea. As more and more techniques are discovered to benefit and develop with this data, the detection of emotional states and brain attention levels is becoming an essential topic for human-computer interaction. Numerous approaches exist for the purpose of emotion recognition. Currently, data may be collected via the use of heart rate monitors, skin conductivity, speech recognition, and temperature sensors. The use of electro-encephalography (EEG) in brain-computer interfaces (BCIs) to assess attention or mood is one of the strategies investigated in this study.

Keywords: Human stress, Heart rate sensor, Neuro-sky sensor, Wi-Fi module, GSM module.

INTRODUCTION:

When we're emotionally or physiologically prepared to deal with an imminent threat, we experience stress. When you're under a lot of pressure, your body goes through a lot of changes, such a faster heart rate, shallower breathing, and less focus. Stress dots and other continual stress sensing gadgets don't provide any relief for the user's temporary tension, either. By filling these voids in the market, we want to establish a method that assists patients and healthcare providers in managing a heightened physiological reaction that has several detrimental health effects, therefore benefiting a large number of people.

It is very difficult, if not impossible, to read people's genuine emotions. Thermoelectric, skin conductivity, speech recognition, and temperature sensors are all part of the current technology. All of these methods gather information that may be used to detect emotions. Brain activity detectors, like electroencephalogram (EEG) scanners, are far and away the most precise sensors. The brain's billions of cells connect with one another via electrical signals. When millions of neurons in the brain transmit messages to one another, the result is a tremendous amount of electrical activity that may be detected by sophisticated medical equipment that measures the levels of electricity across specific regions of the scalp. Electrical activity along the scalp may be recorded using an electroencephalogram (EEG). It detects changes in voltage caused by the passage of ionic current in brain cells. Students' ability to pay close attention in class greatly affects how much they learn. In more conventional, in-person classrooms, professors often read their students' facial expressions to gauge their level of focus. Nevertheless, this approach is very subjective and demands a substantial amount of effort from the educator. It is already difficult to tell whether students are paying attention in a classroom setting when they have the option of online distance learning in addition to traditional in-person training. Under any and all In a constant state of activity, the brain's neurons release minute quantities of electromagnetic waves. As EEG signals, these electromagnetic waves are used. The extent to which pupils are able to pay attention during class is a good indicator of how well they will learn. Improving the learning impacts of pupils may be achieved if instructors can instantaneously detect whether they are paying attention and appropriately urge them to stay focused.

In a constant state of activity, the brain's neurons release minute quantities of electromagnetic waves. As EEG signals, these electromagnetic waves are used. The extent to which pupils are able to pay attention during class is a good indicator of how well they will learn. Improving the learning impacts of pupils may be achieved if instructors can instantaneously detect whether they are paying attention and appropriately urge them to stay focused.

BACKGROUND:

Our ideas and emotions are reflections of the ways in which the brain's billions of neurons interact with one another. When monitored externally from the

skull, the minute electrical discharges generated by each neural connection are inaudible. However, quantifiable waves are formed when hundreds of thousands of discharges occur at the same time. Distinct mental states are triggered by variations in neural connections. While beta waves, which happen between 12 and 30 hertz, are associated with focus and concentration, alpha waves, which happen between 8 and 12 hertz, are associated with relaxation and mental serenity. In response to these patterns, waves of varying frequencies and amplitudes are generated. (As a result of the distinct wave patterns associated with muscle contractions, certain NeuroSky devices are able to identify blinks by separating these patterns.)

Since all electrical equipment, including light bulbs, emit some degree of ambient "noise" when turned on, most electroencephalogram (EEG) devices will still detect waves coming from the brain, even if they aren't really placed on the head. If you attempt to use these waves to gauge mental activity, you'll sound like you're trying to eavesdrop on a rock concert. In the past, electroencephalogram (EEG) devices got around this issue by taking readings in settings with tightly regulated electrical activity and then using a conductive solution to boost the signal intensity of the brain's data.

In order to detect the electrical activity of neurons in the human nervous system, a neurosky sensor is used. A sensor arm, ear chips, and a headset make up the gadget. A sensor arm rests on the forehead, above the eye position, and the reference and ground of the headset are on the ear chip and EEG electrode, respectively. The GLCD display shows the user's stress levels as detected by the microcontroller via bluetooth, which in turn is sent to the sensor by means of alpha or beta waves in the user's brain. A person's emotional state may be revealed by the following levels of brain waves: • Alpha: 8–13 Hz: When you're relaxed, alert, or in a state of full awareness, your brain's parietal and occipital areas generate this kind of periodic wave. Waves don't show up whether you're thinking, blinking, or aroused in any other way. Alpha blocks are what this is called.
When humans are aware and cognizant, the frontal lobes engage in activity known as beta waves, which range from 14 to 30 hertz. Think or be stimulated by your senses, and you'll notice these waves more.
• Theta: 4–7 Hz: The parietal and temporal lobes are the primary sites of this kind of brain activity. Emotional stress, disruptions to awareness, or extreme physical relaxation may all cause the body to generate these waves.
• Delta: 0.5 - 3Hz: The majority of humans have very little delta activity while they are awake; rather, this activity happens during profound sleep, unconsciousness, anesthesia, or when oxygen is not present.
• Gamma: 5–10 Hz: Activity in this frequency range has been associated with selective attention in recent research. Cognitive and perceptual processes are associated with this action, according to other research.
an electrocardiogram (ECG) A heart rate sensor measures the electrical activity of the heart in beats per minute.The device's wrist wear sensor and receiver are what really measure and send the wearer's heart rate to the device's controller. The heart rate output is generated by this controller. Within that two-second time frame, the device continuously detects five beats per minute from the heart.The sensing will be reset if the receiver does not receive it. The user may then check their heart rate on the GLCD display to determine the precise level of stress if the controller detects it properly.
1.1.1 GLCD Screen Graphic liquid crystal display (LCD) technology is an electronic visual display standard primarily utilized in electronic device displays but also in a wide variety of other devices and information-output sources. In order to execute graphical display operations across a two-dimensional physical screen, this technique makes use of precisely controlled electrical impulses to manipulate small crystals in an enclosed liquid crystal solution. Modern liquid crystal display (LCD) technology has largely replaced its predecessor, the cathode ray tube (CRT), which employs an electron-firing cannon to create a pixel-based display on monitor panels. Thin and tiny, with a structural assembly that is extremely tightly integrated, LCDs are visual display units. A typical graphic LCD has five primary layers that run parallel to each other.
Screens of mobile phones, laptops, computers, digital readers, electronic watches, calculators, flat-screen TVs, and many other electronic devices and gadgets that show information visually or in text-based format are the most typical places you'll find LCD. Plus, LCDs have come a long way in their design and operational assembly, allowing them to serve as devices that can handle both input and output. Graphic liquid crystal display (LCD) systems provide several major benefits over older CRT-based VDUs. Additionally, these characteristics have greatly aided in the

incorporation of these visual display units into commercially available portable electronic devices. 1.2 Module for Bluetooth There are two modes of operation for the HC-05 integrated Bluetooth serial communication module, which may be shortened to module: order-response and automatic connection. At the automated connection work mode, there are three work roles: master, slave, and loopback. In automatic connection work mode, the module will send data using the last-set default.
the information mechanically. Modules in order-response work modes allow users to transmit control orders and parameters using the AT command. You may change the module's working mode by adjusting the level of the PIN (PIO11) input. Module for GSM 1.3 As a cellular network, GSM allows mobile phones to link up by scouring the surrounding area for nearby cells. This SIM900 Quad-band GSM / GPRS device operates on the following frequencies: 850 MHZ, 900 MHZ, 1800 MHZ, and 1900 MHZ. It is part of the Global System for Mobile Communications and the General Packet Radio Service. It is a small and simple plug-in GSM modem that is straightforward to use. The modem's 3V3 and 5V DC TTL interfaces make it easy to connect to a wide variety of microcontrollers, including those running the AVR, 8051, and 3V3 versions of the ARM and Cortex XX families. Through the use of AT (Attention) instructions, the baud rate may be adjusted from 9600 to 115200 bps. The user may connect to the internet using the GPRS capability of this GSM/GPRS TTL modem since it features an integrated TCP/IP stack. It works well with applications that transport data between mobile phones and those that provide short message service (SMS). The modem's USART (Universal Synchronous Asynchronous Receiver and Transmitter) capability allows for serial connection with microcontrollers.
1.4 The ESP8266 Wi-Fi module Designed for builders of mobile platforms with space and power constraints, the ESCP8266 family of wireless system on chips (SOCs) offers great performance and integration. It offers the best combination of cheap cost and little space demand with the flexibility to integrate Wi-Fi into other systems or run independently as an application. ESP8266EX provides a full and independent Wi-Fi networking solution; it may run the software itself or transfer Wi-Fi networking tasks to another CPU. The ESP8266EX starts up straight from an external flash when it hosts the program. The system's performance in these applications is enhanced by its inbuilt cache.
The ATMEGA 328 is a low-power, high performance, 8-bit RISC-based AVR microcontroller that combines 32KB ISP flash memory with read while write capabilities. The device is manufactured using Atmel’s high density non-volatile memory technology and is a compatible with the industry standard and pin out. The on chip flash allows the program memory to be reprogrammed in system or by a conventional non-volatile memory.

1. METHODOLOGY AND IMPLEMENTATION

Two kinds of sensors—heart rate and brain wave—are used in this study. The Neurosky sensor picks up on brain waves and shows degrees of tension, focus, and meditation. The Atmega 328 microcontroller is ideal for this project since it is inexpensive, easy to use, and consistently produces accurate results. A device that can monitor the electrical activity of the heart rate by connecting it to the chest is called a chest strap heart rate sensor. The precise process of the heart pumping blood through the body causes the blood volume in the body's arteries to fluctuate as the heart beats. The microcontroller can determine the heart rate by further analyzing the signal. This work's suggested strategy is shown in Figure xx. Figure 1 shows the system's output when the Pluguino board is linked to the GLCD. The data will be analyzed by the controller once the signal has been recorded using the neurosky and heart rate sensors. A heart rate sensor, a neurosky sensor, and a GLCD are the three pieces of code that make up the controller's C programming language. The output is shown using GLCD. You may save the data from your heart rate and Neuro sky sensor taken at various periods using SD Card Breakout. Rhythm monitor

RESULTS AND ANALYSIS

The findings and essential information, such as heart rate and stress level, are acquired from the Arduino system. Displaying the information on GLCD makes the project more practical. Figure 2 shows how it may be seen on a PC using the Arduino software monitor. Figure 3 shows the data collected by the neurosky sensors. Figure 4 shows the heart rate and stress level shown on the glcd.

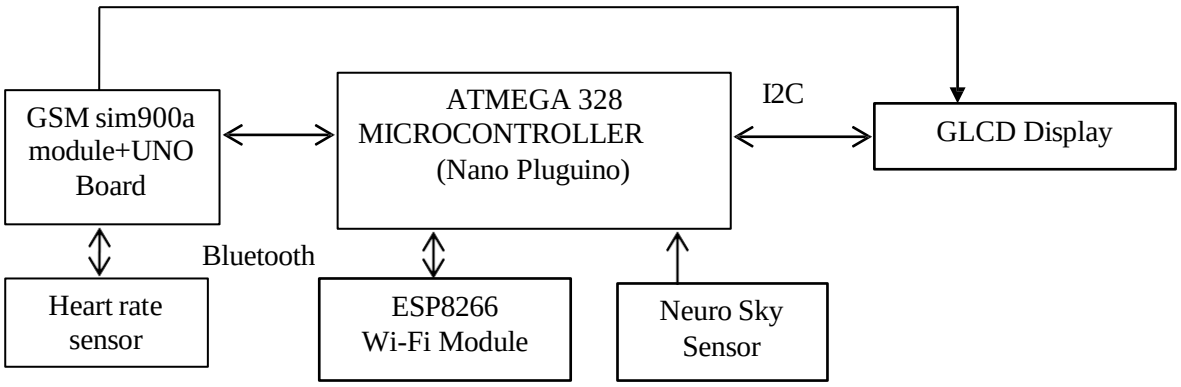

Figure1: Block diagram of the proposed system

Date_Time	Attention_level	Meditation_level	Delta_wave_value	Theta_wave_value
2016-05-02 03:06:51	87	41	18943	20126
2016-05-02 03:06:46	61	8	25148	16385
2016-05-02 03:06:42	50	35	5845	12964
2016-05-02 03:06:37	77	43	41790	6441
2016-05-02 03:06:33	43	38	1106	57951
2016-05-02 03:06:28	77	34	10910	20914
2016-05-02 03:06:24	69	4	12740	55276
2016-05-02 03:06:19	21	8	36147	15495

180-215	50-60	Quietly Relaxed
215-230	60-73	Deeply Relaxed

Table 1. Heart rate and stress level threshold values

Figure 4. Heart rate and Stress level is displayed on GLCD

After the parameters are entered, the system calculates the stress level and returns the results. There are five distinct states of stress: very tense, somewhat tense, calm, tranquilly relaxed, and profoundly relaxed. To accommodate the individual differences, several rules were developed based on the modification of parameters.

SIMULATION RESULTS

In Arduino based system, the execution speed can be measured by timer function included in Arduino. Figure 5 shows

the result of the heart rate. The advantage of the Arduino also is be able to generate the output almost instantly.

Figure 5. Output shown in PC monitor

2. CONCLUSION

Data collected in real-time from the individual with the use of an Arduino Mega board. In conclusion, a stress detector prototype has been constructed using the project's data. It proved that the initiative had accomplished its goal. The signals that the stress detection system picks up on a person's mental state include data that is current and relevant. In addition, the prototype is built to make use of inexpensive hardware and develop a real-time application.
Also, the Arduino Atmega 328 microcontroller is a great choice for implementing such a system in a real-time application since it is portable, inexpensive, and easy to use. Not only that, but the visual output makes the system seem more beautiful and functional. Making a standalone stress detector may help people regulate their stress levels and identify the source of their stress.

3. ACKNOWLEDGMENTS

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