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IoT based smart health device to access psychological stress and management

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Abstract- **In today's world many People feel stressed Out from school, work, or other life events. Therefore, it is important to detect stress and manage it to reduce the risk of damage to an individual's well-being.With the emergence of the Internet of Things (IoT), devices can be made to detect stress and manage it effectively by using cloud-based services and smartphone apps to aggregate and compute large data sets that track stress behavior over long periods of time. Additionally, there is added convenience via the connectivity and portability of these IoT devices. They allow individuals to seek intervention prior to elevated health risks and achieve a less stressful life.**

Keyword-stress detection, automatic Stress detection, stress management.

I. INTRODUCTION

Stress is the body's reaction to harmful situations when you feel threatened, a chemical reaction occurs in your body that allows you to act in a way to prevent injury. This reaction is known as "fight-or-flight," or the stress response.

According to the annual stress survey conducted by the American Psychological Association (APA), average stress levels in the United States (U.S.) rose from 4.9 to 5.1 on a scale from 1 to 10 in 2015. Stress in a person is a state of worry that is produced when responsibilities and events overwhelm one's abilities Stress has been linked to a plethora of emotional and physical conditions, such as depression, anxiety, heart attacks, stroke, hypertension, and immune system disturbances, that increase susceptibility to infections. Furthermore, stress can exacerbate memory and thinking issues. Older individuals experiencing stress may have difficulty controlling anxiety, anger, and depression, which may make them vulnerable to cognitive difficulties. There are three types of stress that are mentioned in eustress, neustress, and distress. Eustress is good stress; it motivates a person to an optimum level of health or performance. Neustress is a kind of sensory stimulus or information that is regarded as unimportant. Distress is bad stress an event's negative interpretation that brings continuous threatening feelings of anger or fear. Figure 1 shows a chart of the different types of stresses that are defined in the field of psychology.

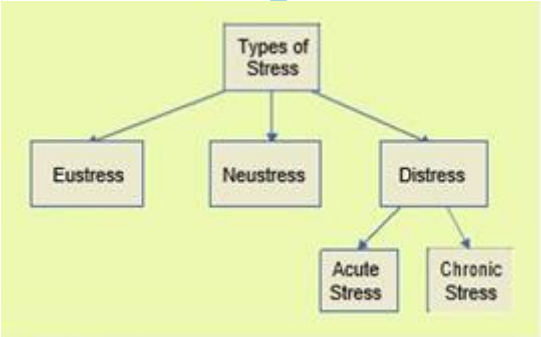

Figure 1. The three types of psychological stresses [1].

As shown in Figure 1, distress can be further divided into two categories: acute stress and chronic stress. Acute stress is considered to be intense but only for a short duration (e.g., seeing flashing police lights in the rearview mirror). Chronic stress stays with the person for a longer time frame (e.g., personal finances).According to the survey in, the four main stressors that Americans feel overwhelmed about are money, work, family responsibilities, and health concerns. The graph in Figure 2 shows each of these stressors from the years 2007 to 2014.

There has been much interest in developing technology that is capable of detecting the symptoms of stress. A survey of current stress detection technologies can be found in. The existence of these technologies has allowed for the creation of a wearable industry, consisting of wearable devices designed to detect and manage stress.

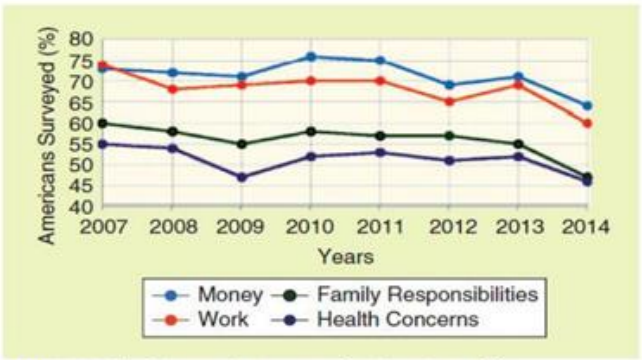

FIGURE 2. The four main stressors for Americans [4].

II. PREFACE TO STRESS DEVICES

Consumers have expressed growing interest in health and fitness, which, combined with advances in technology (such as the IoT), has resulted in the creation of a wearable industry. This industry has seen the rise of companies such as Fit bit in addition to offerings from established technology companies such as Sony, Garmin, and Motorola. Products from these companies allow a consumer to track his or her health and fitness through a single device worn on the body. A subset of

this industry is devoted toward tracking a consumer's mental rather than physical health. These devices are often referred to as mindfulness trackers, and while they may have some fitness capabilities, their main target is tracking metrics such as stress, mood, sleep quality, and so on, which can be characterized as having a more significant impact on a user's mental well-being. Focus will be placed on devices that make the detection and management of stress their main priority.

FEATURE DESCRIPTION OF STRESS DEVICES

There has been much research performed in determining the biological indicators of when a person is under the effects of stress. Some of these include an increase in blood pressure, rapid breathing, and a rise in heart rate. By measuring these indicators, an observer can determine when a person is under the effects of stress. Through the inclusion of a small number of sensors, these devices are able to achieve varying levels of stress detection. The large number of biological indicators of stress allows the devices to have similarly unique and varied approaches in how they detect the stress of a user.

III. BLOCK DIAGRAM

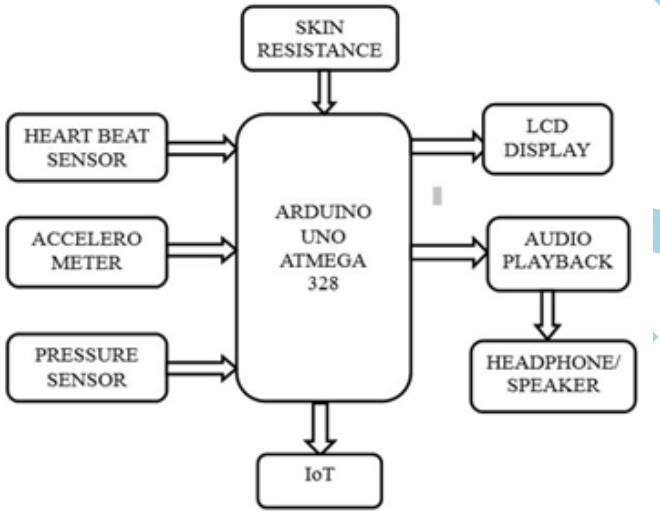

FIGURE 5.1 BLOCK DIGRAM

IV. HARDWERE

The detection of stress is performed by a combination of sensors and algorithms. An overview of the sensors can be found and a brief description of the sensors is given next.

HEARTBEAT SENSOR

Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

ACCELEROMETER

An accelerometer is a device that measures proper acceleration. For example, an accelerometer at rest on the surface of the earth will measure an acceleration g= 9.81 m/s2 straight upwards, due to its weight. By contrast, accelerometers in free fall or at rest in outer space will measure zero. Another term for the type of acceleration that accelerometers can measure is a g-force acceleration. An accelerometer is an electromechanical device that records acceleration forces. These forces can be static (gravity) or dynamic (detecting movements). The three-axis means that the accelerometer can determine the movement in a three-dimensional space. It worn to detect the movement of a person and to determine about more details of the stress level at different positions.

PRESSURE SENSOR

A pressure sensor measures the pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a gas or fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor generates a signal related to the pressure imposed. Typically, such a signal is electrical, but it might also include additional means, such as optic signals, visual signals and/or auditory signals. The SX Series of pressure sensors provide the lowest cost components for measuring pressures up to 150 psi. These sensors were specifically designed for use with non-corrosive, non-ionic media, such as air, dry gases, and the Like. Convenient pressure ranges are available to measure differential, gauge, and absolute pressures from o to 1 psi (5X01) up to 0 to 150 psi (5X150).

MICROCONTROLLER

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. Micro controller is a standalone unit, which can perform functions on its own without any requirement for additional hardware like I/O ports and external memory. The heart of the microcontroller is the CPU core. In the past, this has traditionally been based on a 8-bit microprocessor unit.

DIFFERENT TYPES OF ARDUINO BOARD:

Arduino Uno (R3)
LilyPad Arduino
Red Board

Arduino Mega (R3)
Arduino Leonardo

ARDUINO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a

computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

LIQUID CRYSTAL DISPLAY

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. It is a combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games.

An LCD is either made up of an active matrix display grid or a passive display grid. Most of the Smartphone's with LCD display technology uses active matrix display, but some of the older displays still make use of the passive display grid designs. Most of the electronic devices mainly depend on liquid crystal display technology for their display. The liquid has a unique advantage of having low power consumption than the LED or cathode ray tube.

AUDIO PLAYBACK DEVICE

Most computers have audio recording and playback devices such as sound cards, microphones, headphones, and speakers. You also can customize system sound effects, which are audio clips associated with system events such as emptying the trash or error messages. There are various types of voice processing chip (IC) with various features for speech compression and processing is readily available. The device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. It design for unique quality and storage time needs. Playback and record operations are managed by on chip circuitry. There are several available messaging modes depending upon desired operation. The output of stress detection should be processed from Arduino and send to audio playback if stress is occurs.

IV.SOFTWARE

INTERNET OF THINGS (IOT)

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over anetwork without requiring human-to-human or human-to-computer interaction. It is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and network connectivity which enables these objects to connect and exchange data.

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

"Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, cameras streaming live feeds of wild animals in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring, or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest regarding "things" as an "inextricable mixture of hardware, software, data and service".

IV. STRESS DETECTION AND MANAGEMENT

The main method that most of these devices require to detect stress is the HRV, which is important for investigating para-sympathetic and sympathetic functions of the autonomous nervous system Parasympathetic function is responsible when the body is at rest, and sympathetic function is in charge when the body responds to stressors.

The signal for HRV is calculated by a peak-to-peak time frame on R wave to R wave intervals, or consecutive cardiac cycles. Research shows that if a person has a high HRV, then he or she is fit and in good health, but a low HRV signifies fatigue and stress. An example from shown in Figure 3 illustrates a high and a low HRV. To put Figure 3 into context, if the heartbeat becomes constant (e.g., 1 s for every heartbeat), this is bad and considered to be low HRV, while changes in the heartbeat are a good thing and considered to be high HRV.

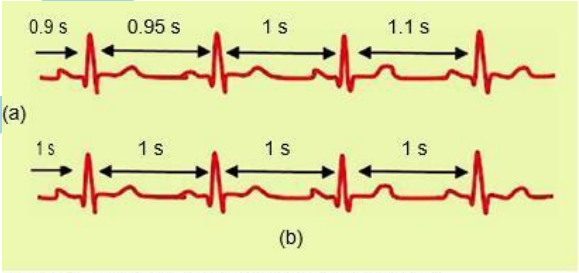

Figure 3. An example of (a) high and (b) low HRV .

CONCLUSION

With the advancement of technology in the IoT spectrum, health professionals and entrepreneurs have designed devices for stress detection and management throughout the day. These devices not only detect stress, but they also incorporate stress management techniques like focused breathing and meditation exercises to relieve the user's stress levels.

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