Stress Detection and Management System

Project Proposal

ECE 445

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Table of Contents

I. INTRODUCTION

Stress beyond normal levels has been shown to be detrimental to a person's health and cognitive abilities. In these instances, daily monitoring and management are essential to alleviate prolonged stress to a manageable level.

In the market today, there are continuous stress-monitoring devices, including: heart rate monitors, breath rate monitors, and stress dots. These devices, however, do not provide the user with assistance in alleviating that stress. There are other products, such as smartphone apps, which if used by the user, give a reading of the user's stress and provide them with assistance to alleviate it. These apps, however, require the user to determine when it is appropriate to check their stress level, thus it is not a continuous monitoring system.

It is our intention to address these gaps in the market and create a system that will, hopefully, be of benefit to a great many patients and health care practitioners by better assisting them in taking control of an elevated physiological response that has so many negative health consequences.

II. OBJECTIVES

Our goal is to create and combine a continuous monitoring device and stress management device into one system. Our continuous monitoring device will be responsible for monitoring the user's stress level, so that the user will be able to concentrate on his tasks throughout the day and be assured that is stress levels are accounted for. A microcontroller will activate the assisted stress management device, when elevated levels of stress are detected. When this device is activated the user will simply follow the guide of the device to reduce his momentary stress.

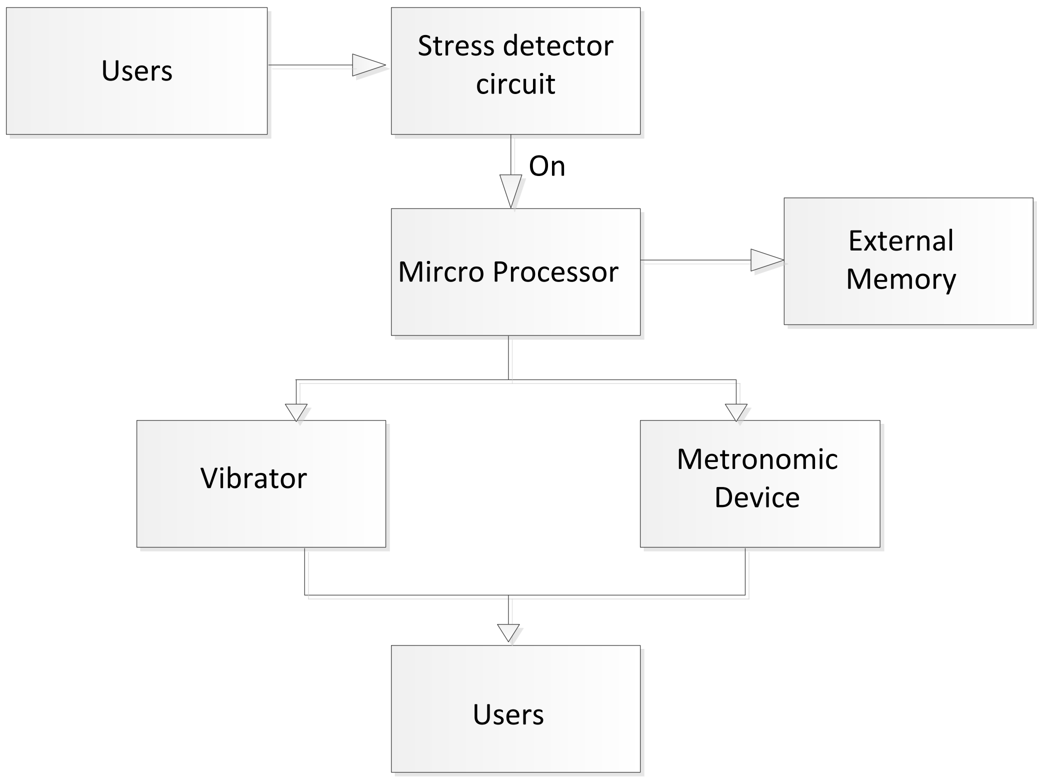
Benefits to End User

- Not concerned with stress level until it is detected
- Assistance in alleviating stress, especially in challenging environments
- Stress monitored throughout the day (as long as device is worn)

Product Features

- Battery operated for portability
- Continuous Stress Detection in any type of light
- Sensory stimulus for notification of stress to user
- Metronomic device for guiding rhythmic breathing
- Microcontroller for ease of operation

III. Block diagram and descriptions



Stress detector

- To determine whether the user got stress or not. If stress dots change the color, circuit will detect it and output to micro-processor. Output is a voltage difference between photodiodes which is an input of micro-processor. If the output voltage isn't significant enough for the micro-controller, we will design an amplifier for this stage.

Micro Processor

- If the changed voltage got detected, it will output to vibrator and metronomic device. It will send information of use's stress to external memory. It will record stress level and time in RAM, and will be able to transfer data by USB. The micro-controller output voltage will be sent through an amplifier, so that enough power will be supplied to turn on the metronome and the vibrator.

Vibrator

- Vibrate when it gets output from micro-processor

Metronomic device

- Activate when it gets output from micro-processor

IV. PERFORMANCE REQUIREMENTS

Stress Detector:

- Photodiode differentiates between at least two colors (stressed state and relaxed state)
- Stressed state output voltage level 50% larger than relaxed state output voltage

Micro-Controller:

- Differentiates between stressed state voltage and relaxed state voltage
- Stores time and state of user
- Outputs voltage required to turn on vibrator and metronome

Vibrator:

- Vibrates within 5% of specified frequency, acceleration, and time in use
- On/off state controlled by microcontroller

Metronomic Device:

- Constant beat of audio signal
- On/off state controlled by micro-controller
- Different frequency for in-breath, hold, and out-breath

V. VERIFICATION

TESTING PROCEDURES

Round One (Modular Testing):

Stress Detector:

1. We will first test the photodiode circuit with two objects of the same color as the stressed state color of stress dot and the relaxed state color of stress dot. We will send the output signal of our detector circuit to an oscilloscope to verify that the voltage difference between the two colors is adequate for our microcontroller. We will do three trials of this test. If the voltage difference is not adequate, amplification will be needed and we will run the test another three times.
2. We will then test the circuit with the stress dots, which will go through multiple color changes. Our circuit, however, will have a threshold color that we will assign as a level with enough stress to activate the vibrator and metronomic device. We have to control the temperature change of the stress dots for the purpose of the test. We will alter the color of the stress dots by attaching it to a container filled with water. We will alter the temperature of the water with a heating coil by enough variation to change the stress dot color from a relaxed state to a stressed state. Our detector will detect the color change of the stress dot and the output will be displayed on an oscilloscope and we will determine if two voltage levels with enough separation are outputted. We will also have to detect a color change from a stressed state to a relaxed state. This will be done by also making an ice water solution and applying the stress dot to the glass of the container. This back and forth of neutral to stressed to relaxed will be done in five separate trials, to ensure consistency of results

Micro-Controller:

1. We will test the program that we will design for the micro-controller. This test will consist of inputting two different voltage levels and checking for the correct stress state output.
2. We will test the micro-controller to make sure it outputs the correct voltage to turn on the vibrator and metronome during stressed state detection. We will also test to see if it shuts off power to these components during relaxed states.

Vibrator:

1. Testing for the vibrator will include testing for the correct frequency, acceleration and time of vibration.

Metronomic Device:

1. We will test for timing of the count. The timing must be constant and the ratio for in-breath: hold: out-breath must be fixed for each round of breathing.
2. We will test to make sure the decibel level of the output audio will be within 5% of our specification.

Round Two

System Test:

In this round we will attach the stress dot to a user, and alter his stress level. With the entire systems set up, we should see the microcontroller differentiate between the stress state and the relax state. The micro-controller should then turn on or off the management system based on the stress state. We will run this system test at least for five trials.

TOLERANCE ANALYSIS

It is important to know the voltage levels that correspond with different colors detected by the photodiode. For our purposes a significant stress state color should output a noticeably different potential difference across the photodiode than a relaxed state color. If it does not, then an amplifier will have to be added to our detector circuit. We are proposing that a potential difference corresponding to a stressed state color should have a 50% difference from a relaxed state color, within +- 10%. For example, if the stressed state color corresponds to a 5mV potential difference then the relaxed state color should be represented by either 2.5 mV or 7.5mV within 0.5mV.

VI. <u>Costs</u>

Labors

Name	Hourly Rate	Total work hours	Salary
Yong Ho Kwon	$20	100hr	5,000
Udara Cabraal	$20	100hr	5,000
Hong Lee	$20	100hr	5,000
Total	$60	300hr	15,000

Parts

Name	Price	Quantity	Provider	Cost
Micro-controller (Arduino)	$ 25	1		$ 25
LED (white)	$ 5	1 pack (25)		$ 5
Photodiode	$ 1	1		$ 1
Stress Dot	$ 0.99	5		$ 4.95
Parts for metronomic device	$ 20		Estimated	$ 20
Parts for detectors	$ 20		Estimated	$ 20
Parts for vibrators	$ 20		Estimated	$ 20
Bluetooth Chips	$ 3	2		$ 6
TOTAL				$ 101.95

VII. Schedule

Week	Task	Group Member
9/16	Finishing proposal	Kwon, Lee, Cabraal
9/23	Complete ordering parts	Kwon
9/30	Build circuits for stress detectors	Lee
10/7	Compile program to Micro-controller	Cabraal
10/14	Design metronomic device	Kwon, Lee, Cabraal
10/21	Design vibrator, Individual proposals due.	Lee
10/28	Complete the total design 1.	Kwon, Lee
11/4	Complete the total design 2.	Kwon, Cabraal
11/11	Testing the device 1.	Kwon, Lee, Cabraal
11/18	THANKSGIVING	
11/25	Testing the device 2.	Kwon, Lee, Cabraal
12/2	Demos	Kwon, Lee, Cabraal
12/9	Presentation	Kwon, Lee, Cabraal
12/16	Exam Week	