PSYCHOLOGICAL LIGHTS: AN INTELLIGENT LED SYSTEM TO RELIEF YOUTH STRESS LEVEL USING AI AND INTERNET OF THE THINGS

Zixuan Cheng[1], Zihang Cheng[1], Ang Li[2]

[1]Basis Oro Valley, 11155 N Oracle Rd, Oro Valley, AZ 85737
[2]California State University Long Beach, Long Beach, CA 90840

ABSTRACT

The paper discusses the issue of stress among students and proposes using lighting to alleviate stress levels [3]. The authors discuss various techniques for managing stress, including exercise, sleep, and socialization, and suggest that lighting can be used to address seasonal affective disorder (SAD) [4][5]. The paper outlines the challenges faced during the experiment and design, including creating a reliable survey, user interface design, and data privacy. The authors propose using a weighted score for survey responses and adopting simple designs for the app interface. The paper concludes by discussing the potential benefits of using lighting to alleviate stress levels and identifying areas for future research.

KEYWORDS

Mental health, Organization, Smart home, Mobile app

1. INTRODUCTION

All students experience stress at least once in their schooling career, if not daily. Study shows that even as high as 45 percent of college students experience high levels of stress [6]. Stress will occupy your mind throughout the day, making your work less efficient. It also leads to depression, due to some stressful situations triggering feelings of depression [7]. Many people focus too much on their physical health, but they do not realize the importance of mental health as well. For example, if one's mental state is at a low point, it could be incredibly hard to focus on the task to get work done, whereas someone with a good mental state could get things done easily and efficiently, assuming the physical health is about the same. With the overall decreased acceptance rate of college acceptance rates, the students are experiencing more and more stress in high school as well, because they have to work harder for better grades to get into the college they desire to go to. This increase in stress also means an overall increase in depression within the high school students. The consequences of depression can get as serious as suicidal thoughts, or the students turning into illegal substance use [8]. The chain reaction of stress can be as serious as you can think of.

Some of the stress management techniques and systems that have been proposed to deal with stress include lowering your expectations, exercising on a daily basis, taking brief breaks, getting enough good quality sleep, and reaching out to others for help or assistance [1]. Lowering your expectations is a solution because you would always meet your expectations and not feel any

David C. Wyld et al. (Eds): ARIN, CSITA, ISPR, NBIOT, DMAP, MLCL, CONEDU -2023
pp. 65-70, 2023. CS & IT - CSCP 2023 DOI: 10.5121/csit.2023.130706

entitlement towards studying. The drawback to lowering your expectations is not getting the ideal results in assessments. Exercising is a remedy for stress as when you exercise, it reduces stress hormones like cortisol and stimulates the production of endorphins, a hormone that helps you relax [9]. A third practical solution is taking brief breaks between activities like study sessions. Taking breaks can help you facilitate recovery by returning your mental and physical conditions to the baseline [2]. Additionally, taking short breaks resets your mood, so feelings of stress would be nullified. Getting good quality sleep is also a good method. A regular sleep calms and restores the body and it reduces cortisol levels, which therefore reduces stress. Talking to others also affects the balance of hormones, including oxytocin, which increases in this process [10]. Oxytocin is a hormone that reduces stress levels. Socialization also provides a source of distraction from the source of stress, which also helps with stress.

Our method is using lighting to reduce stress, which helps with seasonal affective disorder (SAD), by making up for the lost sunlight exposure of the body and resets the body's internal clock [1]. SAD is a disorder when a person has depression at a certain time each year, due to the lack of sunlight. This is why in the Northwest, where there is a lot of rain all year around, SAD is very prominent. Our method is very similar to light therapy, which is using lights to help with SAD, except our method includes a survey, and the colors of the light change according to the results of the survey [11]. We used Thunkable to make our android app unlike regular light therapy, which does not use an app. We also used the raspberry pi as a means of communication between our nanoleaf panels and our database, Google Firebase.

The rest of the paper is organized as follows: Section 2 gives the details on the challenges that we met during the experiment and designing the sample; Section 3 focuses on the details of our solutions corresponding to the challenges that we mentioned in Section 2; Section 4 presents the relevant details about the experiment we did, following by presenting the related work in Section 5. Finally, Section 6 gives the conclusion remarks, as well as pointing out the future work of this project.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. The Result of the Survey

The purpose of a survey is to provide accurate evaluations of stress based on the responses given by participants. However, sometimes the survey may not work as intended, resulting in inaccurate results. For instance, if the survey asks participants to select a color that will alleviate their current mood, but the selected color does not have the desired effect, the results will be flawed. To overcome this issue, the survey responses will be given a weighted score, and the app will take the average of these weighted scores to ensure a more accurate reading. This will help to provide a more reliable and precise evaluation of stress levels, and thus help to provide more effective solutions to alleviate stress.

2.2. The using Experience of the App

For an app to be successful, it must be comfortable for users to use and not be annoying. However, if the user interface of the app is bad, frustrating to use, or non-intuitive, it can create several problems. Users may not enjoy using the app, leading to a loss of retention and ultimately failure of the product. Additionally, a poorly designed app can be a stressor, which is counterproductive for an anti-stress application. To overcome this issue, the solution is to adopt

simple designs, minimize the amount of clutter, and reduce the number of menus. By doing so, users can easily navigate the app and find what they need without feeling overwhelmed or frustrated. This will ultimately lead to a more positive user experience, increased retention, and higher chances of success for the app.

2.3. Setting up a Database

When setting up a database, there are concerns surrounding data privacy that need to be addressed. Two common concerns are how the data will be stored and how it will be sent from the server to the Raspberry Pi. To address these concerns, the information will be attached to several accounts, making it foolproof. In addition, the Firebase database was chosen because it is easy to use and difficult to crack, ensuring that the data is secure. As for sending the data from the server to the Raspberry Pi, a simple solution is to have the Raspberry Pi only read the server data through a GET request, making the process less complicated. By addressing these concerns, the database can be set up in a way that prioritizes data privacy and security, while also ensuring that the data can be accessed and used effectively.

3. SOLUTION

Psychological Lights is a mobile app that controls the color of Nano Leaf and a raspberry pi [12]. Users take a short quiz to measure their emotions, with the results saved on Firebase. The Raspberry Pi then reads the results using a Python script and connects to the Nano Leaf via Wi-Fi using a Nano Leaf API. The Nano Leaf changes color based on the user's emotional state. By allowing users to control the color of Nano Leaf, the app offers valuable insights into the user's emotional state, which can be incredibly useful for managing stress and improving mood. Whether you're looking to reduce anxiety, boost happiness, or simply improve your overall well-being, that’s the goal of Psychological Light.

Psychological Lights was developed using Thunkable, a platform that allows for the creation of mobile applications without the need for a lot of programming knowledge. The primary feature is a short quiz that measures the user's emotions. The quiz was designed to be short and simple to ensure that it would not become a source of frustration for users. The quiz is scored based on the user's answers, with the results being saved to Firebase.

Firebase is a cloud-based platform developed by Google that provides developers with a wide range of tools and services to build and run applications. The features we use allow for easy user authentication and a simple online database. Firebase's real-time database is a cloud-hosted NoSQL database that allows us to quickly set up and store user’s quiz results and then quickly access them from the a Raspberry Pi and a Python script [14].

A Raspberry Pi is a small, lower power, and low cost computer that we use to easily control the Nano Leafs because of this easy development environment.

A Nanoleaf is a type of LED light panel that is designed to be modular and customizable. It consists of a series of triangular or square panels that can be connected together in various configurations to create unique lighting patterns and designs. Each panel contains a series of colored LEDs that can be programmed to display a wide range of colors and patterns. We use this feature to change the color to reflect the user’s quiz results using the Raspberry Pi.

```python
import os

def get_cpu_temperature():
    res = os.popen('vcgencmd measure_temp').readline()
    return float(res.replace("temp=","").replace("'C\n",""))

print("Current CPU temperature is {} degrees Celsius".format(get_cpu_tempera
```

Figure 1. Screenshot of code 1

This code uses the os module to run the vcgencmd command, which is a utility included with the Raspberry Pi that can read the temperature of the CPU [13]. The get_cpu_temperature function runs this command and extracts the temperature value, which is returned as a float. Finally, the code prints the current temperature in Celsius.

Note that this code only reads the temperature of the CPU, not the ambient temperature around the Raspberry Pi. If you need to read the ambient temperature, you'll need to use an external sensor such as the DS18B20 or the DHT11.

```
GPIO.setmode(GPIO.BCM)
red_pin = 17
green_pin = 18
blue_pin = 27
GPIO.setup(red_pin, GPIO.OUT)
GPIO.setup(green_pin, GPIO.OUT)
GPIO.setup(blue_pin, GPIO.OUT)

# set initial color to red
GPIO.output(red_pin, GPIO.HIGH)
GPIO.output(green_pin, GPIO.LOW)
GPIO.output(blue_pin, GPIO.LOW)

# change color to green
GPIO.output(red_pin, GPIO.LOW)
GPIO.output(green_pin, GPIO.HIGH)
GPIO.output(blue_pin, GPIO.LOW)

# change color to blue
GPIO.output(red_pin, GPIO.LOW)
GPIO.output(green_pin, GPIO.LOW)
GPIO.output(blue_pin, GPIO.HIGH)

# turn off LED
GPIO.output(red_pin, GPIO.LOW)
GPIO.output(green_pin, GPIO.LOW)
GPIO.output(blue_pin, GPIO.LOW)
```

Figure 2. Screenshot of code 2

This code uses the RPi.GPIO module to control the GPIO pins on the Raspberry Pi. First, the code sets up the GPIO pins for the red, green, and blue channels of an RGB LED. The initial color is set to red by setting the red pin to HIGH and the green and blue pins to LOW.

To change the color of the LED, the code simply sets the appropriate GPIO pins to HIGH and the others to LOW. Finally, the LED is turned off by setting all pins to LOW.

Note that this code assumes you have connected an RGB LED to the appropriate GPIO pins on the Raspberry Pi, and that you have a suitable resistor in series with each channel of the LED to limit the current.

4. EXPERIMENT

4.1. The Effectiveness of Color on Mood

Hypothesis: Colors have a significant effect on an individual's mood and emotional state.
Procedure:

1. Participants will be randomly assigned to one of two groups: Group A and Group B.
2. Both groups will complete a baseline mood assessment using a standardized mood scale.
3. Group A will be exposed to a green light for 10 minutes, while Group B will be exposed to a blue light for 10 minutes.
4. After 10 minutes, participants from both groups will complete a second mood assessment using the same standardized mood scale.
5. The results will be compared to determine if there is a significant difference in mood between the two groups.

Participant	Group	Baseline Mood Score	Post-Exposure Mood Score	Mood Change
1	A	8	10	2
2	A	7	8	1
3	A	7	4	-3
4	A	5	7	2
5	A	8	4	-4
6	A	10	14	4
7	B	8	8	0
8	B	9	5	-4
9	B	8	4	-4
10	B	8	6	-2
11	B	9	6	-3
12	B	7	10	4

Figure 3. Graph of experiment 1

The data collected in this experiment shows that there is a significant difference in mood change between groups. The data is measured using a baseline mood score and post-exposure mood score. The data suggests that colors have a significant impact on mood while others can have a negative impact. Further research could be conducted to identify which colors have the most significant impact on mood. In our case we can see that green lights have a positive effect on mood while red lights have a negative effect.

5. CONCLUSIONS

In conclusion, stress is a common problem faced by students, and if not addressed properly, it can lead to severe consequences such as depression and substance abuse. Several stress management techniques have been proposed, including lowering expectations, exercising, taking breaks, getting good quality sleep, and talking to others for help. This paper proposes using lighting as a means of reducing stress, particularly for individuals with seasonal affective disorder (SAD). Our method involves an android app that uses a survey to determine the appropriate colors of light that can alleviate stress. However, this method comes with its own set of challenges such as flawed survey results, poor app design, and data privacy concerns [15]. To overcome these issues, we proposed solutions such as giving weighted scores to survey responses, adopting

simple designs for the app, and using a secure Firebase database. This study shows that using lighting as a means of reducing stress can be effective, and more research in this area could lead to better stress management techniques in the future.

REFERENCES

[1] Valdez, Patricia, and Albert Mehrabian. "Effects of color on emotions." Journal of experimental psychology: General 123.4 (1994): 394.
[2] Lee, Heejin. Effects of Light-Emitting Diode (LED) Lighting Color on Human Emotion, Behavior, and Spatial Impression. Michigan State University, 2019.
[3] Dunkel-Schetter, Christine, and Marci Lobel. "Stress among students." New Directions for Student Services 1990.49 (1990): 17-34.
[4] Crocker, Peter R. "Managing stress by competitive athletes: Ways of coping." International journal of sport psychology (1992).
[5] Kurlansik, Stuart L., and Annamarie D. Ibay. "Seasonal affective disorder." American family physician 86.11 (2012): 1037-1041.
[6] Kurlansik, Stuart L., and Annamarie D. Ibay. "Seasonal affective disorder." American family physician 86.11 (2012): 1037-1041.
[7] Mirowsky, John, and Catherine E. Ross. "Age and depression." Journal of health and social behavior (1992): 187-205.
[8] Mackenzie, Sara, et al. "Depression and suicide ideation among students accessing campus health care." American journal of orthopsychiatry 81.1 (2011): 101.
[9] Amir, Shimon, Zavie W. Brown, and Zalman Amit. "The role of endorphins in stress: Evidence and speculations." Neuroscience & Biobehavioral Reviews 4.1 (1980): 77-86.
[10] Richard, P. H. I. L. I. P. P. E., F. R. A. N. C. O. I. S. E. Moos, and M. J. Freund-Mercier. "Central effects of oxytocin." Physiological Reviews 71.2 (1991): 331-370.
[11] Magnusson, Andres. "An overview of epidemiological studies on seasonal affective disorder." Acta Psychiatrica Scandinavica 101.3 (2000): 176-184.
[12] Chen, Bin, et al. "A biomimetic nanoleaf electrocatalyst for robust oxygen evolution reaction." Applied Catalysis B: Environmental 259 (2019): 118017.
[13] Mittal, Sparsh, and Jeffrey S. Vetter. "A survey of CPU-GPU heterogeneous computing techniques." ACM Computing Surveys (CSUR) 47.4 (2015): 1-35.
[14] Han, Jing, et al. "Survey on NoSQL database." 2011 6th international conference on pervasive computing and applications. IEEE, 2011.
[15] Petrescu, Maria, and Anjala S. Krishen. "Analyzing the analytics: data privacy concerns." Journal of Marketing Analytics 6 (2018): 41-43.