Development of EEG Based VR Application for Chakra Guided Meditation

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Abstract

This paper studies how to properly meditate in a VR environment and increase the effect of chakra meditation by real-time EEG data. Meditation on the chakra is beneficial for the health of the body. For ordinary people, the chakra is invisible and unimaginable. Therefore, we developed the application in a VR environment. Users can sit inside a non-distracting environment with chakra visualization. The application can understand the condition of the user using the EEG data during the chakra meditation.

Keywords: Chakra, Meditation, EEG, VR, Mindfulness

1. Introduction

There are many meditation applications developed in the market that have a positive impact on people who are under tremendous pressure in modern times.

Virtual reality (VR) enables a person to be isolated from the environment and enter a separate space, thus reducing distractions. However, the majority of VR meditation applications use too many visual effects. It even places the users in a beautiful simulation world. Users find it difficult to focus on meditation. Limit stimuli are used only in a small number of applications but produce better results [1]. Therefore, this application is designed to utilize only the necessary visual guidance. Users can concentrate on meditation.

There are many methods of meditation. In this application, we introduce chakra meditation. Human life exists in two parallel dimensions, the 'physical body' and the 'subtle body.' In Figure 1, the subtle body consists of Nadi (energy channels), which are connected by the nodes of the energetic chakra ("cycles" or "wheels") [2].

For the general public, it is difficult to imagine the chakras. We show the position of the chakra in a human model that sits on the opposite side. Guides users on the chakras and positions they must focus. Colors, patterns, and sound frequencies that correspond to the chakra are also used to enhance the effect of meditation.

Most meditation applications guide users by voice or visualization. However, it is a one-way guide. No

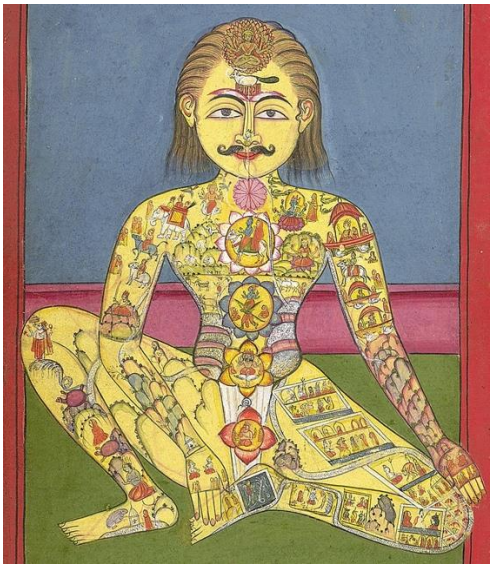

Fig. 1. Chakras from the 17th Century.

feedback method is available, and it is impossible to change according to the condition of the user. Therefore, the EEG is used in our application to determine whether the user is focused on meditation. It is used as a reference guide in the chakra meditation application.

2. Background

2.1. *Mindfulness meditation*

Positive meditation has been reported to be relaxing [3][4] and to improve physical health [5]. We often have a problem of thought that considers the past or the future; therefore, we need special training on it.

The primary purpose of mindfulness meditation is to focus on the present without judgment [6]. Our mind often thinks about the past or the future, so it needs special training and methods. Many forms of meditation have been developed since ancient times. Such focus is the breath, thought, or candlelight, contemplating a flower within, etc. The goal is essentially the same: to heal and relax the mind, body, and spirit. It is beneficial for maintaining physical and mental health.

Although chakra meditation has not become a method of mindfulness meditation, the goal is the same. In addition, chakra meditation may achieve more significant benefits. The user has a more precise focus: focus on the chakra facilitates the user to let go of mental judgments. The functions of the chakra are related to the energy of the body, and their balance contributes to physical and mental health. For the average person, the concept of chakra is challenging to imagine and feel. Therefore, we rely on VR and visualization as guides for chakra meditation.

2.2. *Virtual reality for meditation*

The use of VR as meditation allows people to disconnect from their daily environment and enter a different world conducive to meditation. Users are easy to immerse themselves in a virtual world. It could be a computer-generated or an omnidirectional video of the real-world [7] [8] [9]. Figure 2 shows the screenshot of an application. However, it is better to reduce the interaction and distraction in the virtual environment (VE) [10]. Most meditation methods require the user to close their eyes for better results. Therefore, our designs tend to be minimally visually guided. We use a mannequin sitting on the opposite side of the room to show the positions of every chakra and use visual effects and sound to guide the user on which chakra to focus at the moment.

Fig. 2. A screenshot of Nature Treks VR [9].

2.3. *Chakra and frequency*

The theory of the chakra has been passed down from ancient times to the present. It is still present in modern society and is gaining more and more attention. The major chakras are arranged in the center of the body and correspond to the organs and secretory glands of each part of the body. They are also related to emotional aspects. Therefore, the balance of chakra energy helps to improve the state of mind and body.

The major chakras can correspond to different colors, sounds, and crystals. Optics and sound waves are different fields of frequencies. In quantum mechanics, the smallest fundamental particle is the string [11], which is vibration frequency. That is, the world is constituted by vibrational frequencies. Therefore, the use of corresponding frequencies in chakra meditation can be a real help. The frequency change of the sound also serves as a reminder, so that even with the eyes closed, the user can notice when it is time to switch to the next chakra.

2.4. *Electroencephalography (EEG)*

EEG sensors can detect brainwave signals, and it is possible to identify the user's attention [12]. Most applications are challenging to understand the users' status, have no feedback and are hard to quantify. The application can receive 500 EEG data per second and parse them through Looxid Link Core to provide concentration, relaxation, and balance of the left and right brains [13] [14]. It also provides alpha, beta, gamma,

delta, theta, and other values updated every 100 ms. These data are transmitted to Unity programs via the unity API. We use the built-in EEG function to detect the user's concentration status in real-time and switch to the next pulse when a certain target is reached.

3. Design

3.1. *System architecture*

The development environment is an Intel I7 PC on a Windows 10 system. The graphic card is the NVIDIA GeForce RTX 2080TI. The programming language C# has been used to develop the application in the Unity SDK. The VR system is the VIVE Pro. We use the Looxid Link for the EEG device [13]. Its capabilities are easily integrated into the VIVE Pro. The system architecture is illustrated in Figure 3 and Figure 4.

3.2. *Chakras*

The location of the seven major chakras and the color and frequency of the reflected sound are related in Table 1.

The matching of the pulse to the color is certain. However, there are different theories for matching the sound's frequency. However, it is all based on the use of 432 Hz. To find the frequency Pn, the following definition may be used:

$$P_n = P_a \left(\sqrt[12]{2}\right)^{(n-a)} \quad (1)$$

P_a : the frequency of a reference pitch (432 Hz).
n : numbers assigned to the desired pitch.
a : numbers assigned to the reference pitch.

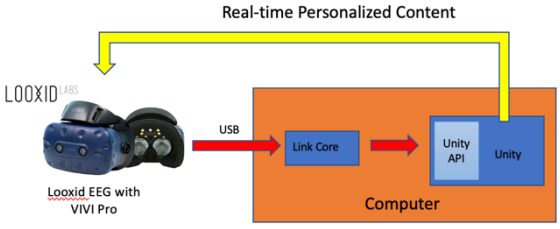

Fig. 3. Device and system structure.

The result of the frequency can be obtained in Table 2.

As shown in Figure 5, the octave note C as Root is used to derive the frequency corresponding to each chakra as the sound to be played during chakra meditation.

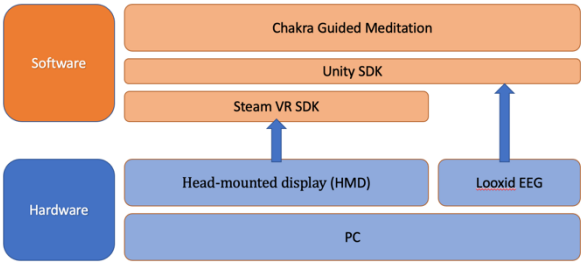

Fig. 4. System architecture.

Table 1. Chakra and attributes. (Source from M. Alcantara 2017 [15])

Chakra	Location	Color	Octave Note
Crown	Top of Head	Violet	B
3rd Eye	Brow Centre	Indigo	A
Throat	Base of Neck	Blue	G
Heart	Chest	Green	F
Solar Plexus	2 inches above navel	Yellow	E
Sacral	2 inches below navel	Orange	D
Root	Base of Spine	Red	C

Table 2. Pitches with a frequency of 432 Hz

Note	*Frequency (Hz)*
A3	216.00
A#3	228.84
B3	242.45
C4	256.87
C#4	272.14
D4	288.33
D#4	305.47
E4	323.63
F4	342.88
F#4	363.27
G4	384.87
G#4	407.75
A4	432.00

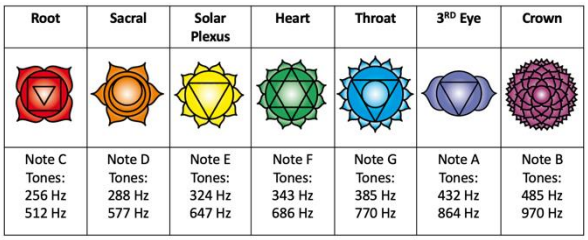

Fig. 5. Chakra tone based on a 432 Hz grid.

How to guide and indicate the current chakra position of the user for meditation has been considered. Considering the need to keep the body upright during meditation, we place a seated figure in front of the user. In order not to let the user have extra imagination about this figure or ask who he is, we design his form as non-physical and unrecognizable. His body is marked with chakras. The user can follow the meditation in sequential order from the root chakra to the top chakra.

The application will display colors and totems of the chakras according to the current chakra to enhance the meditation effect, as shown in Figure 6. Totems will change size according to the user's EEG data and will change their size in real time. However, we have to be careful, as the visual effects may distract the user. In addition, to understand the user's meditation status, we use EEG to detect whether the user is concentrating on meditation and reaches the standard before moving on to the next chakra. The application is designed to achieve a concentration level of 70% and hold it for more than 1 minute. In addition to meditating from the root chakra, users are free to choose to meditate on a particular chakra. This prevents beginners from being stuck in the root chakra and unable to move forward.

Fig. 6. User meditation in the application.

4. Result

Rick Ireton's study showed that some people are more sensitive to 432 Hz as the root chakra [16], so the application can provide options for users to choose the right frequency for themselves.

In addition, if only the sine wave frequency is used, it is not comfortable for the general public. Therefore, we use the sound of a Tibetan singing bowl as a sample [17] and then adjust the frequency according to the frequency table.

In the VR experience, how to create a safe and calm feeling in VR, but not too much visual impact. The first version was designed in a darker environment, which was scary for some people who thought they were going to play some scary game. Therefore, we can put firewood or candle flame in the scene, because the fire will make people feel warm and safe.

The EEG test needs more adjustment to make meditation effective for the user and not too difficult. We consider allowing the user to choose the difficulty level to achieve the right approach for the individual.

5. Conclusion

This application allows the user to perform chakra meditation in VR by guiding the user to perform a particular chakra meditation through video and sound frequencies. The EEG detects whether the user has reached the effective goal and proceeds to the next chakra. The images and sounds will not only guide but also help the chakra. We also try to use a minimum of visual effects as a guide to reduce distracting and flashy effects.

In the prototype version, we tested the effect of different sound frequencies on each chakra to find the right sound frequency. But we also need to maintain the flexibility to allow users to choose.

An important issue in VR is how to provide a comfortable and secure alternative without distracting the user. This sense of peace of mind varies from person to person, often depending on their own experiences. Therefore, it is necessary to provide different scenarios so that users can choose the right place for them. However, care must be taken not to become a world that the user wants to explore.

The last issue is about the use of EEG. Different levels should be added for users to choose and even the difficulty level can be adjusted flexibly with the users'

use. If you are considering multiple users, you can set up to 3 users, record each user's usage status, and let the users adjust the difficulty level by themselves or automatically by the application.

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