Use of Virtual Reality Technology in Breathing Techniques

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1 PROBLEM STATEMENT

VR Breathing is a virtual reality application that has different objects that the user can interact with using their breath. This application produces an alternative way to visualize one's breath as it is in a safe virtual controlled environment so the user will not get harmed with these objects. In addition, the user can utilize the tool to learn more about their breathing patterns with different senses because one cannot directly see their breaths as they are invisible.

The main objective of this project was to solve this lack of visualization of one's breath and to produce a tool that allows them to improve their breathing performance. This was achieved by having the user be able to perform breathing exercises with a visual aid showcasing their personal breathing in comparison to the exercise.

1.1 Motivation

The main goal of this project was to design a program that allows the user to improve their breathing performance by observing their breathing habits through the use of the sense of sight. The goal was to have this application be a tool for people with breathing issues to work on their breathing habits.

1.2 Current Work

Currently there are different breathing techniques that people use such as square breathing (4-4-4-4), guided minute long breathing exercises (Google's Minute Breathing), Headspace web application, and 4-4-8. These exercises are great for practicing breathing. In addition, all these applications or breathing techniques only showcase what the user is expected to be doing rather than focusing on what the user should be doing. Headspaces is the only application, within our research, that has a meditation video that provides the task of placing the users hand on their stomach to follow the rising and falling of their breathing.

2 NEED FINDING

2.1 Textual Inquiry

First we perform a textual inquiry to obtain professional knowledge for this area. To start understanding the VR breathing application, we consulted with the Professor and the TA. In addition, since we wanted to use a breathing exercise within our application we had to do research on different breathing exercises. We learned that there were many different exercises and are used for different things. Many of the breathing exercises were associated with meditation and the calming of ones mind.

2.2 Survey

After textual inquiry we conducted two surveys. The first survey allowed us to obtain information about potential users' input on which exercises work best. We found through our survey that many users had used the Google's Minute Breathing exercise and the 4-4-4-4 exercise. This survey was also used to gain insight into if people would want an application to help visually their breathing. The results showcases a more neutral stance with many participants saying "Maybe" rather than a firm "Yes" or "No". The second survey was used as a post user study survey to understand the users stance on the application after use of it. This survey was filled out after the completion of their turn on the application.

2.3 Sample Survey Protocol

For our first survey procedure, we distributed the survey to as large of a population as possible, resulting in 50 University of Delaware students responding. We aimed to contact University of Delaware students as they would be the ones participating in the study due to our time frame and location. The survey was created using Google Forms and it was distributed by student group chats for different clubs and organizations. Some of these organizations included the UDCIS Discord, Honors Athletes, and UD Varsity Women's Tennis.

For our second survey procedure, we distributed the survey to those that participated in the experiment. They received it after the experiment is completed. We aimed to obtain a few participants with a wide range of differences in breathing ability and knowledge. The survey was built be using Google Forms.

3 PROTOTYPING

3.1 Device

For this application, we used a VR headset because that was how the original project was using. The use of the headset allows the participants to experience the visualization tools the best as they are in a virtual reality. These headsets are lightweight, easy to adjust, and are used by many participants outside of this study for other applications. In addition, they allow the user to be placed in a reality where they can primarily focus on the task at hand.

3.2 Storyboard

We created two storyboards for this application. The first storyboard showcases the initial idea of adding sounds to the bottle feature in order to give people the sense of sound to understand their breathing patter. The second storyboard showcases the final idea of adding a visual bubble to showcase the users breathing along with a breathing pattern. The storyboards below are a way to showcase our goals for the project and what we had hoped others can achieve by the use of it.

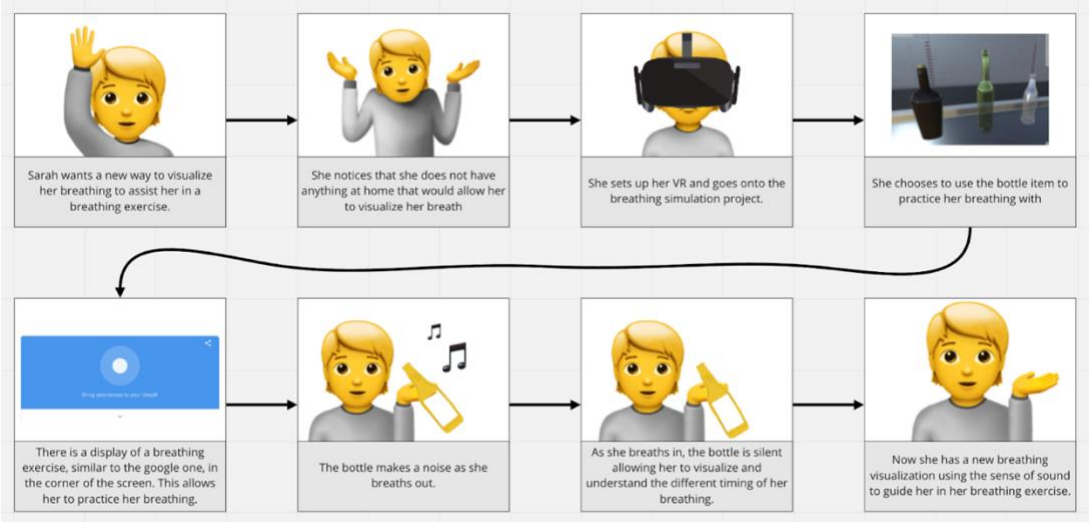

Figure 1: Initial Storyboard for VR Breathing created by Viva Laas

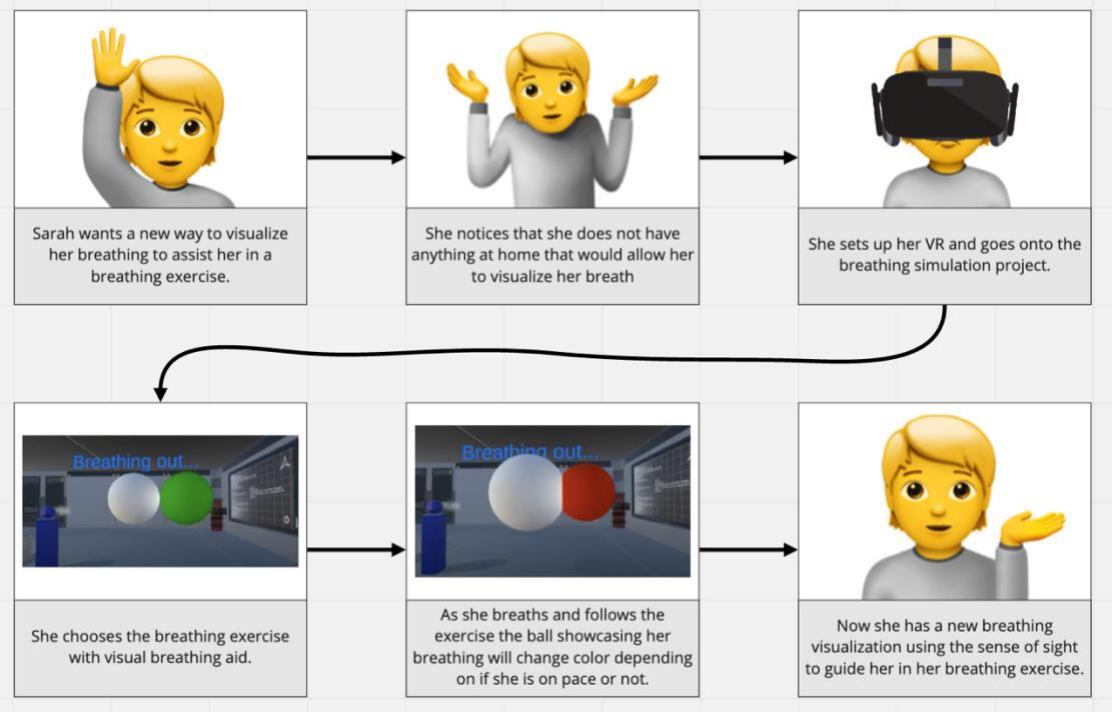

Figure 2: Final Storyboard for VR Breathing created by Viva Laas

3.3 Prototype Fidelity

The final project is fully functional with the concept we had in mind and in using the VR headset. However, we are missing a wind sensor that would enhance the project as currently it is using a simulation by the use of buttons. We classify the

project as fully functioning because the users can do what we set out to do: have a feature to showcase a breathing exercise and a feature to show a visual of the users breadth. In addition, we achieved our goal of seventy-five percent of breadth as our project is mainly set on the look and feel however there are still some more shading and editing we could have achieved had there been more time.

4 IMPLEMENTATION

4.1 Technology

Since the project was started in virtual reality, we deemed it was best to continue with that route. In addition, technology advances allows a lot of people to have virtual reality these days making the application still be accessible with this choice. By using virtual reality, we allow the users to experience a reality where they can focus upon the task at hand. In addition, it allows for excitement with the use of VR to drive users to enhance their breathing in a fun interactive manner.

4.2 Features

The product brings two new elements to the original VR Breathing application. These features are two bubbles, one of which expands and shrinks to the signal the user to breathing in or out. This bubble mimics the Google One Minute Breathing Exercise as we found that would be the simplest to implement and easiest for new users to understand. The other bubble is also expanding and shrinking however this bubble is controlled by the user's breathing in or out. These new features allow a user to have a visual feature to aid them in performing better on breathing exercises.

4.3 Challenges

Our largest challenge for the project was not having a breathing sensor. This means that we had to make our application a simulation and the user has to manually press buttons to showcase if they are breathing in or out. This means that the readings are not as accurate as we had hoped for. In addition, another large challenge of the project was learning Unity. As this was our first time using it we had a lot to learn in a short amount of time. Lastly, the time frame was also a challenge as we wanted to get a lot done.

4.4 Potential Solutions

An alternative solution we first thought of was to add a balloon feature that would allow the user to see a balloon get larger as they breathe in and shrink as they hold their breath or breathe in. This solution would have provide another visual based solution to our proposed motivation. Another alternative would have been to implement a dandelion animation that would have pieces of the flower float away as the user breathes out and appear back as the user breathes in or holds their breath. Another visual we could have implemented was sound. The basic idea being that as the user blows out they would hear the sound of the bottle making a whistling noise and as they breathed in there would be silence. Lastly, the implementation of a wind sensor would allow the user to use their actual breathe when simulating the breathing.

5 USER STUDY AND STUDY EVALUATION

5.1 Hypothesis

For our evaluation approach, we are hypothesizing that if we create a virtual reality that allows users to use the senses of sight with a breathing exercise then the user will complete the exercise in a better manner of understanding and correctness. This hypothesis will serve as our goal and projected outcome for this project.

5.2 Experiment

We conducted a within-subject experiment with four students. The students were picked from reaching out to the same group chats as the pre survey was and thus seeing who was able to. We had each student complete the One Minute Google Breathing Exercise and one minute breathing exercise using our application. This way we can compare how the users breathing was with the two applications. We made observations as they did each exercise.. In addition, we will look into the concept of if it was helpful, what needs improvements, and if the product is usable. We did not have a control condition as it is not very feasible. If we were able to have a control condition it would be a baseline of breathing understanding or the pace someone breaths during normal breathing exercises.

5.3 Results

The four students that we had participate in our experiment were friends that had reached out to our messages on the group chats sent. This means that there may be some bias within the result, although the participants were told to be brutally honest during the experiment.

The metric we are using to propose that our solution was better than what exists today was how well the users performed and felt they were on pace with the exercise on our application in comparison to the One Minute Google Breathing Exercise. This was achieved from observations we took while each participant participated in the experiment and the post survey each participant filled out.

From the post survey and our observations we found that our application did as we hypothesized. From our users survey we concluded that two users said they felt that our application was more helpful to focus than the One Minute Google Breathing Exercise and another felt both were equally helpful. In addition, two of the four users found that our application was helpful for practicing their breathing while one found it neutral. Lastly, two participants found our application helpful on controlling their breathing while one student found it neutral.

5.4 Different

If we were to be able to continue and produce a new study we would make improvements to our application and produce a similar experiment. When we conducted our experiment we found that 3 out of 4 participants said we needed improvements in the breathing techniques applied. That being in mind, we would add different breathing exercises that the user could choose from. That way the user can use something they are more comfortable with. In addition, we would implement the wind sensor to get a more accurate reading of the users breathing. For the experiment portion, we would do a within subject experiment again but this time have more participants with different backgrounds in breathing. We would try to get some people who are having breathing difficulties and seeing if our application helps them.

Overall, this project helped improve our research skills along with teach us about Unity and breathing exercises. This project showcases the power of breathing and how people may have difficulties with it. In addition, this project taught a lot about time frame and being under pressure to complete research in a limited time.

6 ALTERNATIVE APPROACHES

6.1 Potential Challenges

The VR did not have a wind sensor, meaning that the user had to be honest in their manual input of when they are breathing out and when they are not. This will posed a challenge since the entirety of the product depends upon the user's breathing input. In addition, the VR set is dependent on a laser transmitter that helps to determine the user's actions and environment. If one of these lasers were to be broken then the VR set will have a harder time calibrating to the environment making the program harder for the user to use.

6.2 Fallback Plan

In the case of the user having to simulate, we observed our users breathing during the experimentation to make sure they were being honest. As for the VR, we checked each equipment piece to make sure it is in good condition. In addition, we used different cords to connect the headset.

7 TIMELINE AND DELIVERABLES

First Proposal Submission 11/19/2021 (Viva, Minghao, Jinheng, Jiamian)
Develop Working Prototype 11/9/2021-11/27/2021 (Jiamian, Minghao)
Develop Survey 11/16/2021-11/18/2021 (Viva, Jinheng)
Send Survey and Analyze 11/18/2021-11/20/2021 (Viva, Jinheng)
Showcase of the Project Presentation 12/1/2021 (Viva, Minghao, Jinheng, Jiamian)
Working Product Completion 12/8/2021 (Viva, Minghao, Jinheng, Jiamian)
Showcase of Project Demo 12/8/21 (Viva, Minghao, Jinheng, Jiamian)
Compose User Study 12/9/2021 (Viva, Jiamian)
Create and Edit Video 12/10/2021-12/12/2021 (Jinheng, Jiamian)
Completion of Website 12/9/2021-12/15/2021 (Viva, Jinheng, Jiamian)
Submission 12/17/2021 (Viva, Minghao, Jinheng, Jiamian)

8 BIO

Viva Laas is an undergraduate student in the College of Engineering at the University of Delaware, pursuing a Bachelor's of Science degree in Computer Science with a concentration in Software Engineering. Her interests include how to create better User Interfaces for software applications.

Minghao Zhao is an undergraduate senior studying in the UD computer science department. He is willing to design an outstanding user interface for the software his group designed.

Jiamian Wang is an undergraduate senior studying Computer Science at University of Delaware. He is willing to create software that eases daily life.

Jinheng Zhang is an undergraduate student in the Computer Science department of University of Delaware. He is interested in the field of artificial intelligence.