Accessible Virtual Reality Tools for Reducing Stress

Problem statement:
Virtual Reality Therapy (VRT) can be a useful tool for improving stress management and reducing the stress of users\(^1\). However, many virtual reality applications used for VRT are designed for high-quality, expensive headsets like Oculus and Vive. At prices that range from several hundred to several thousand dollars, the cost of these headsets makes them generally inaccessible to the average user. On the other hand, Google Cardboard is an extremely cheap headset that only costs a couple of dollars, and will work with apps on the iOS and Android devices which are ubiquitous today, making Cardboard-based VR applications much more accessible.

The high-level goal of this project is to make virtual reality as a tool for reducing stress and anxiety more accessible to users. The project seeks to create a VR iOS app to be used with a Cardboard headset that shows the user one or more immersive, calming environments to reduce the user’s stress and anxiety. If time allows, I plan to create multiple VR environments with varying levels of interactivity, ranging from those requiring no user input to those requiring moderately frequent user input, which the user can choose depending on their current mood and needs.

High-Level Goals:
- Creation of a VR iOS app used with the Google Cardboard headset that creates an immersive environment suitable for reducing stress and anxiety.
- Creation of one or more complete 3D environments with 360° views that include visuals and audio to create an immersive experience in the app. The user will be sitting or standing in place while using the app and there will be no controls to make the user’s character move around in the environment, so the app only needs to handle rotational movement.
- The app should be a functional VR app; i.e. the visuals should appear three-dimensional to a user wearing the headset, the app should respond quickly to head tracking and user input, and it should not cause the average user discomfort or motion sickness due to lag or incorrectly rendered environments.
- Evaluation of the app as a tool for reducing stress and anxiety: performing studies (perhaps only informal ones) to determine whether users feel calmer and less stressed after spending time using the app, and whether they are motivated to use it again in the future.

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Goals for VR Environments

- If time permits, multiple environments with varying levels of interactivity, ranging from no user interaction needed to moderate levels of user interaction needed, so the user can choose what experience they want based on how much they feel like directly interacting with the app.
- At the very least, one main, dynamic environment in the app that responds to user interaction: a virtual garden.
  - The user can view, tend, and change their virtual garden.
  - The user can plant different types of seeds, remove plants, and water plants to make them grow.
  - The app encourages repeated use by having the plants grow over time. If the user waters their plants, leaves the app and returns after some time, the plants will have grown.
  - Since the app is meant to reduce stress, plants will not die if they are not watered; watering will simply cause plants to grow and develop in more interesting ways.
  - The user’s garden is saved and reloaded upon opening the app so the user does not have to start from scratch every time. They will also have the option to erase the garden and start anew.
- If time permits, I will also add additional environments that require no or lower levels of user interaction, possibly views of night sky or the ocean, if the user does not feel like or does not have the energy to interact with the app and make choices.

Tools, Software, and Languages for Development:

- Objective C and Xcode – for developing the iOS application
- C# and the Unity development platform – for developing the 3D environments
- Google VR SDK for Unity – for developing VR handling head tracking, 3D calibration, user input, etc.

Milestones:

- Setting up tutorial apps, learning how to setup Unity iOS games for Cardboard, establishing a foundation in the basics of programming a VR iOS app.
- Developing a menu that shows on app startup which allows the user to enter the environment, or to choose their environment if there are multiple options.
- Developing a basic VR environment (sky, ground, static objects) that does not respond to user input.
- Developing a VR environment that responds to user input (e.g. planting seeds on the ground causes plants to appear)
- Saving and loading environments so the user can return to a garden they worked on previously.
- Introducing more complex options for user input (e.g. selecting an existing plant allows you to remove or water it)
- Introducing more variation in objects that appear in the environment
  - Have different kinds of plants and objects you can place in your garden, and allow the user to select which kinds of plants to grow.
• Creating a dynamic environment that changes over time
  o If the user exits the app and later reopens it, their plants will have grown. Plants may change in the following ways: they get larger, they change color, they may develop flowers or fruit.
  o This should encourage the user to re-use the app in the future.
• (if time allows) Animating a more realistic environment
  o e.g. Leafy plants move in a “breeze”
• (if time allows) Creating multiple different environments so the user can choose their experience.
  o Other environments will have lower levels of interactivity, and will just be calm environments with relaxing audio that users can look at.
• (if time allows) Porting the app to different iOS versions and iPhone versions. At first I will only focus on making the app run on an iPhone 5 with iOS 9, but would like it to run on other iPhones and iOS versions if possible.
• Conducting studies to measure participants’ stress levels before and after using the app.

Deliverables:
• An iOS app that runs on iPhone 5 with iOS 9
• Starting up the app and using it with Google Cardboard shows a 3D VR environment
• The environment responds to user input so the user can add and remove plants from their virtual garden
• The environment should respond to head tracking quickly enough to prevent motion sickness; essentially, the app should be a functional VR app that doesn’t cause the average user discomfort.
• The user can save and load the environment so they can return to the garden they were working on before they closed the app.
• Plants in the virtual garden should change over time as the user tends to them.
• Studies conducted to measure participants’ stress levels before and after using the app.
  o May ask them to self-report stress levels, or may measure heart rate or breathing rate.
  o May ask them to report their likelihood to use the app again.