Proposed Additions to PROACTIVE Style Guide

2.0 Visual Style

2.1 Art Style

A Low-poly game art style, an art style which utilizes a limited number of polygons to create 3D models will be used for all aspects of this project. This will help to achieve a minimalist,

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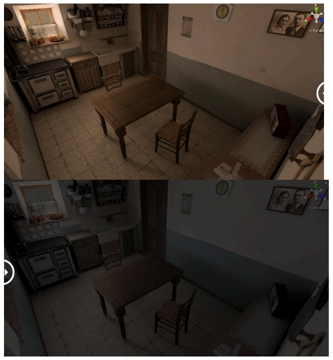
stylized look for the game, but to also reinforce the focus on the model's overall shape and form rather than intricate and sometimes unnecessary details of individual objects. Low-poly objects will also help with the time frame of the project, allowing for object creators to not focus on high resolution objects but instead focus on creating objects that can be used within the project.
That being said, it is important to make sure that each object has a district and recognizable outline even from a distance within the VR experience. This art style revolves around the utilization of strong shapes and strong angles. A low-poly art style works best for our project because it will create a realistic simulation, but will not overwhelm individuals that are using VR for the first time.

2.2 Accessibility with Color

Along with the color combinations to avoid present in the Style Guide 0.5, one more should be added to the color systems. The combination of Midnight Blue (#23344D) and Intense Rust (#90382D) should be added together on the problematic pairs. Together their contrast ratio is a 1.67:1, and fails the AAA test which recommends a 7:1 for normal text and 4.5:1 for large or bold text. This color combination has different hues; however, the contrast between the two may be insufficient for users with low vision or color blindness, especially in VR where blending of neighboring colors causes visual fatigue.

2.3 Environment Lighting

The VR experience that is currently in development is special because the first target audience is elderly individuals, which most likely do not have any experience with VR. While designing this environment we want to keep key factors in mind with our end users, who may have disabilities with their eyesight, hearing, or even interacting with the environment. To make the environment as accessible as possible, giving the house hold in the VR 'stage lighting' will allow all objects to be equally lit, as referred to as ceiling lighting or ambient lighting. Using a series of 'baked lights', lights that are pre-rendered and are static within the room, we can achieve a sound-stage like lighting allowing for limited disorienting shadows, better color contrasts, and potentially limit physiological stress (Li et al.).



Dynamic lighting could be applied within the game to show the progression of the weather outside. Dynamic lighting is any lighting that changes within the environment, for example the sun peaking in and out of clouds during the day. To express the emergency of the climate throughout the experience, dynamic lighting would help the attention of the user to be drawn towards the outside conditions. This type of effect happens post-unity, lighting effects are applied to the virtual camera buffer. This effect would utilize color grading in the post-production phase, and would apply a filter over the experience, this filter would fade in and out as the weather emergency occurs. (Li et al.).

2.4 Shadow Design

Lighting in VR games is one of the easiest ways to depict realism, even in a low-poly environment. The use of shadow and highlights will also help create depth with low-poly objects we are using to create the space. When creating the space we want to keep in mind the purpose of the final project, and that is to see how elderly individuals will react in a disaster environment, we want to make sure that the final environment is realistic but also not too hyper-realistic which can lead to higher cybersickness rates, headaches, and even dissociative experiences which makes it hard to depict real life from VR games (Stankiewicz).

A good middle ground would be using ‘baked shadows’ which are pre-rendered shadows on static pieces and often go hand and hand with the baked lighting technique talked about previously. These ‘darken areas’ around each object would use lightmaps, pre-calculated lighting and shadows of a given scene to reduce the need for in-game, real time calculations. Real-time calculations slow the experience down, and when we are trying to collect data from our users, buffering or a laggy experience could create swayed or untrue results (SimLab).

2.5 Polygon Count and Texture Resolution

Polygon count is important to maintain good performance in a VR environment. Polygon counts should allow fluid gameplay without compromising detail. Since the target audience for this environment includes seniors, everything should be simple but still detailed enough to make sure that they can identify and recognize it easily.

The guidelines will be as follows:

Small Objects: (ex: handheld objects, emergency supplies): About **500-1000** polygons. Under 500 is ideal to ensure smooth gameplay.

Medium Object: (ex: furniture): About **1000-3000** polygons.

Large Objects: (ex: walls): About **3000-6000** polygons.

Texture resolution should be high enough to make sure that objects appear clearer. Make sure that it does not exceed necessary resolution because we want to avoid any strain on the VR system, especially for seniors.

The guidelines will be as follows:

Small Objects: **512x512** to **1024x1024** resolution.

Medium Objects: **1024x1024** to **2048x2048** resolution.

Large Objects: **2048x2048** to **4096x4096** resolution.

3.0 Prevention of Motion Sickness

Motion sickness and dizziness post-experience are common side effects in VR, even with vast research to determine the cause of these symptoms there is still not a clear issue to either include or remove from VR worlds. That being said, a publication from the International Journal of Human- Computer Interaction highlighted key factors which are highly associated with Cyber Sickness. This section will highlight the main points presented within that research and what could be modified in our disaster simulation to limit Cyber Sickness.

3.1 Hardware

Each VR headset is created differently, with an option of having a LCD, OLEAD, or microLED panels which each have different pros and cons. WIthin this experiment we will be using the Quest Pro which utilizes a LCD display, which are cheaper options within VR headsets and do well with color and brightness reproduction. That being said, the LCD headsets that we are designing for have a lower contrast ratio to OLED headsets, which means we need to make sure neighboring colors within the experiment will follow all of the color guidelines previously outlined. Another con of working with an LCD headset is that they sometimes suffer from motion blur. Motion blur occurs when the user rapidly moves their head, which the headset needs to catch up to the user's movement. This rapid blurring occurs in real life, but when in a false reality can result in motion sickness or even nausea.
To resolve the motion features, and improve the users experience we will need to resolve the motion blur caused by users. To do so we should increase our frame rate, allowing for less ‘jumps’ between each shot while there is movement in the user’s head. In most cases, a frame’s on time (or lit time) to off time (black time) displays aim for an on-to-off ratio of less than 10% on and 90% off during black frame insertion. However, reducing the on time places greater demand on the display’s peak brightness capabilities (“Overcoming Motion Blur”).
The Quest Pro has a 1800x1920 dot display, and is known for having one of the best displays to prevent motion sickness. We are working with one of the best systems known to reduce motion sickness with functions including body tracking, allowing for more natural movements and allowing to adjust more settings on the headset unlike competitors. So the design of the objects and the colors are replicated within the headset almost perfectly unlike other headset.

4.0 Visual Cues

To confirm all users, no matter their age or any disabilities they may have are able to properly interact with the environment, visual cues will be made with accessibility and ease in the forefront.

4.1 Interactive Objects

Objects that the user can interact with will have a soft, glowing outline to indicate that they can be directly interacted by the user. This color should be a color that will not blend in with the rest of the objects within the environment. The color proposed by

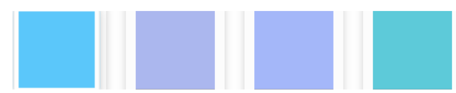


Figure 3:
#00AFF color blocking based on color blindness our group is #00CAFF, which is shown on the far left. The following 3 colors shown in Figure 3 are how a person with protanopia, deuteranopia, or tritanopia would see them, respectively.

This highlight will be equipped when the user is within a 3 ft radius from the item, and only as the object is in the user's view. Items which are behind walls, cabinets, or any other object.

Citations:

Chang Li, Shutong Ge, Yiping Jiang, Effects of simulated natural light brightness on visual perception in virtual reality forests: An eye-tracking study, Journal of Environmental Psychology, Volume 99, 2024, 102446, ISSN 0272-4944, https://doi.org/10.1016/j.jenvp.2024.102446.

Di Bonaventura, Iolanda. "Lighting for VR." *Vajont VR devBlog*, 24 July 2020, vajont.artheria.it/en/lighting-for-vr/. Accessed 3 Apr. 2025.

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Stankiewicz, Caitlin. “Certain about Uncertainty: The Dangers of Virtual Reality.” *River Campus Libraries*, University of Rochester, 30 Mar. 2023, https://www.library.rochester.edu/about/news/certain-about-uncertainty-dangers-virtual-reality.

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