Earth: Our Future

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Abstract

A Unity-based VR project called *Earth: Our Future*, developed for the CAVE2™ Virtual Environment[1], seeks to educate users about how human activity affects the environment and motivate them to take action to protect and restore our planet's ecosystems. The virtual experience was also designed and engineered to address one of the United Nations' 17 Sustainable Development Goals: Climate Action. Users are submerged in a visually arresting virtual environment that illustrates the devastation caused by pollution and environmental degradation in this interactive 3D experience. Users are tasked with bringing the natural habitat back to its former splendor in order to spread awareness of the significance of both individual and group responsibility in protecting our planet. *Earth: Our Future* aims to empower users to take significant steps toward a greener, healthier world, both within the virtual realm and beyond, by fostering a sense of accomplishment and connection to nature.

CCS CONCEPTS • Typography: Using different font styles • Human-centered computing • Environment-friendly technological design.

Additional Keywords and Phrases: Augmented reality, virtual reality, gratitude, unity, blender, 3D, social interaction, environment friendly.

1 Introduction

The global community faces an unprecedented climate crisis, and it is crucial to take action to protect our environment and the species that inhabit it. Our group decided to create a 3D environment in unity. To achieve this interactive 3D experience and aims to increase users' understanding of how human activity affects nature and motivate them to take part in ecosystem conservation and restoration. The VR project itself was named

Earth: Our Future to appeal to an audience's personal perspective and illustrate that caring for the environment on earth is related to caring for humanity's and our own future.
Users of *Earth: Our Future* are submerged in a gorgeous virtual world that illustrates the devastation that pollution and environmental degradation cause. Players are tasked with cleaning up trash, planting milkweed flowers to support the butterfly population, and purifying a polluted lake to create a healthy ecosystem for aquatic life in order to restore the natural habitat to its former splendor.

Users will develop a deeper understanding of the natural world and the significance of preserving its delicate balance as they investigate the meticulously crafted topography. Successfully completing these tasks will result in a breathtaking visual transformation, culminating in a vibrant rainbow typographic display that symbolizes the positive impact of the users' actions on the environment. *Earth Our Future* provides an engaging and accessible platform for learning about and contributing to climate action, promoting an understanding of the importance of individual and collective responsibility in preserving our planet for future generations. By instilling a sense of accomplishment and connection to nature, we aim to empower users to take meaningful steps toward a greener, healthier world, both within the virtual realm and beyond.

1.1 **Accessibility**

Navigation: Providing navigation options can ensure that users who cannot use a mouse can still interact with the project. For example, users should be able to navigate the virtual environment and complete tasks using their keyboard or controller alone. Color Contrast: Ensuring sufficient color contrast between text and background will make the content easier to read for users with visual impairments. Using tools such as the WebAIM Contrast Checker can help to ensure the color contrast meets accessibility standards. Audio Description: Providing audio descriptions for any visual elements of the project can help to ensure that users with visual impairments can understand the content. For example, describing the virtual environment and the tasks that need to be completed using audio descriptions can be helpful. Typography: Using different font styles, sizes, and vibrant colors can help to highlight the key messages and make the content more engaging for users. For example, the phrase "Earth: Our Future" could be displayed in a larger font size and bold color to draw attention to the project's title.

1.2 **Related work**

Figure 1. *Buoy* is a project made by Jinjin Zeng, Yingyi Lin, and Russell Samson designed for the CAVE2™ Environment during the Fall 2021 semester for Creative Coding. We took inspiration from this project when forming a project concept related to the Sustainable Development Goal of Climate Action.

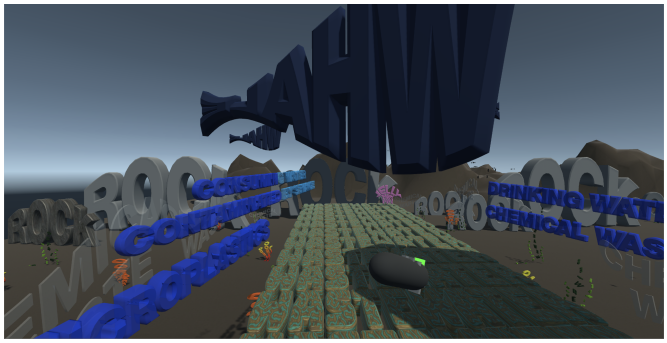


Figure 2. A second view of *Buoy.*

Figure 3. A side comparison of a red fox (front), coyote (middle), and wolf (back) standing.

We read an array of articles related to the animals and environment we selected for our project, such as the monarch butterfly, the gray wolf, and an assortment of fish all of which are found in North America near rivers and prairie lands. We later simplified our models based on the archetypes we discovered in our research. We found on National Park Service's website that Yellowstone experienced a chaotic influx of elk, deer, and fish upon the lack of wolf presence and gray wolves' endangerment from 1926 to 1974. This imbalance resulted in a major lack of resources for these overpopulated species and their companions. Further research into the subject revealed that it is necessary to have a healthy dynamic of predators and prey to maintain a functional ecosystem. We wanted to showcase this aspect in *Earth: Our Future* by including the wolves and humanizing them by having one speak to the user.

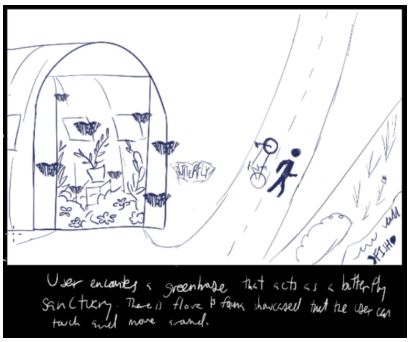
1.3 **Inserting CCS concepts**

Animations: CSS animations could be used to add movement and interactivity to the virtual environment. For example, animations could be applied to the trash to simulate it being picked up and thrown away. Color Scheme: Using a consistent color scheme throughout the project can create a cohesive and visually-appealing experience for users. Shades of green and blue are commonly used to represent nature and ponds, while bolder options, such as a saturated analogous palette can be used to represent a rainbow.
3D Effects: CSS 3D transforms could be applied to create a sense of depth and perspective within the virtual environment. Typography: Using different font styles, sizes, and colors can highlight key messages and make the content more engaging for users. Environment: *Earth: Our Future* has several environment-friendly aspects that make it a valuable tool for promoting sustainable behavior and environmental awareness.

1.3.1 **IDEATION AND EXPLORATORY RESEARCH**

The ecosystem inspiration started from the Chicago River. We had several discussions about incorporating the Chicago River, leading us to base the animals in the environment on those found around the Chicago River. We continued to create alternate animals through research and ideation.

1.3.2 Figures and their descriptions



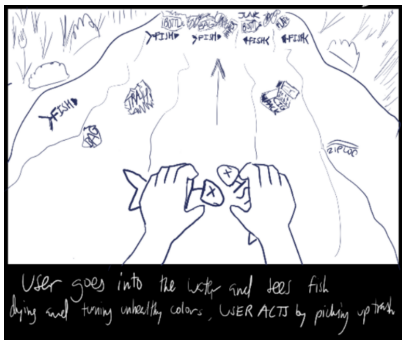


Figure 4. After brainstorming, the storyboard was created to show early ideas of the environment, interaction, and how the user would work to accomplish the tasks at hand.

Figure 5. Side view of wolf model.

Figure 6. Monarch butterfly model.

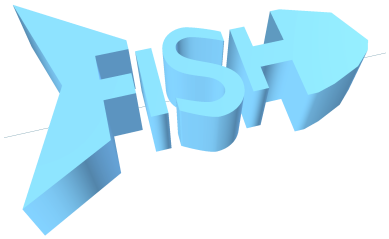


Figure 7. Healthy fish model.

Figure 8. Plant model of milkweed.

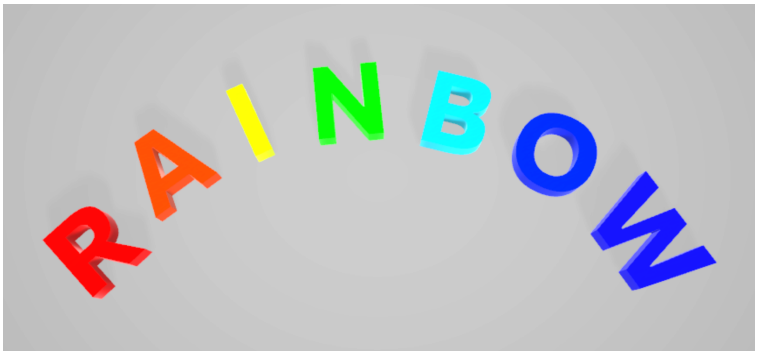


Figure 9. Model of R-A-I-N-B-O-W with each letter in a different color.

Typography in *Earth: Our Future* conveys the importance of environmental protection along with the rewarding effects of preserving nature's delicate balance by showcasing a collection of animal and nature-themed custom typographic designs.

Wolf (Figure 5): We wanted a sharp but friendly design for the wolves, as the wolves are then humanized by presenting the quest and speaking to the human who is able to help restore the habitat. The main features that identify the typographic wolf as such are its small ears, lifted tail, and serrated teeth.

Butterflies (Figure 6): The butterflies are one of the most noticeable creatures in the initial scene with their bright orange wings pointing outward, yet it is not until they are animated that their transition into a scene of liveliness is complete.

Fish (Figure 7): The fish consist of a small and fragile shape. Initially, the fish start off with a muddy brown color, but with the user's interaction to clear their habitat of litter, the fish instantly switch colors into a sky blue.

Milkweed (Figure 8): The milkweed's flowers being in fuchsia enables the user's attention to be drawn to them by the structure's natural, spiky shape being intertwined with vibrant bursts of flowers.

Rainbow (Figure 9): The rainbow was the final asset created for the scene. It is a collection of colors and letters spelling out and forming the arc of a rainbow. Once all of the tasks have been completed, the rainbow floats down to celebrate.

1.4 Code and Concepts and algorithms

Some of the main interactions that were done in this project are as follows:

Butterfly Interaction

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class ButterflyController : MonoBehaviour
{
    public GameObject player;
    public float distanceThreshold = 2.0f;
    public float moveSpeed = 2.0f;
    public float moveAmplitude = 1.0f;

    private Vector3 startPosition;
    private bool isMoving = false;

    void Start()
    {
        startPosition = transform.position;
    }

    void Update()
    {
        float distance =
Vector3.Distance(player.transform.position,
transform.position);

        if (!isMoving && distance < distanceThreshold)
        {
            isMoving = true;
        }

        if (isMoving)
        {
            float newY = startPosition.y +
Mathf.Sin(Time.time * moveSpeed) * moveAmplitude;
            transform.position = new
Vector3(transform.position.x, newY,
transform.position.z);
        }
    }
}
```

Figure 10. This coded interaction includes public variables for the player object, distance threshold, move speed, move amplitude, private variables for the starting position, and a boolean flag for whether the butterfly is moving. The script calculates the distance between the butterfly and the player. If the distance is less than the distance threshold, this condition sets the boolean flag to true, indicating that the butterfly should start moving.

Flower Planting Interaction

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class FlowerPlanter : MonoBehaviour
{
   public GameObject dirtObject;
   public GameObject flowerPrefab;
   public LayerMask groundLayer;
   public int maxFlowers = 4;

   private int numFlowersPlanted = 0;

   void Update()
   {
      if (Input.GetMouseButtonDown(0))
      {
         Ray ray =
Camera.main.ScreenPointToRay(Input.mousePosition);
         RaycastHit hit;
         if (Physics.Raycast(ray, out hit, Mathf.Infinity,
groundLayer))
         {
            if (hit.collider.gameObject == dirtObject &&
numFlowersPlanted < maxFlowers)
            {
               GameObject newFlower =
Instantiate(flowerPrefab, hit.point,
Quaternion.identity);
               numFlowersPlanted++;

               // Add animation here
               Animator animator =
newFlower.GetComponent<Animator>();
               if (animator != null)
               {
                  animator.SetTrigger("Plant");
               }
            }
         }
      }
   }
}
```

Figure 11. The above code allows the user, within a certain distance, to click and plant milkweed flowers for the butterflies. Here, the concept is similar to that of the butterfly interaction.

Figure 12. A wide-angle shot of two students in the CAVE2™ Environment exploring the project.

Solution

The project's solution aims to unify the user with their environment, and create an empathetic view into the lives of other creatures dealing with the devastations of pollution. When the user first enters the scene, piles of trash are visible on both water and land. The scene is crowded with wildlife while the contrasting heaps of plastic litter the scene. Our solution, starting at humanization of the animals and insects, is to encourage the user to become active in putting an effort toward a cleaner environment and reflects an even deeper, psychological issue of desensitization to litter in real life. The initial scene captures the destruction of an ecosystem with helpless creatures living in and around it; The final scene brings out splashes of color in the altered color of the fish, lively animation in the family of butterflies, and vibrance in a large rainbow being brought out as one of the many remarkable aspects of nature.

We designed the project to prioritize user interaction over explicit contextualization of the problem. In the project, the user is able to interact with the trash, bottles, and cans on the ground by picking them up via the directional up button on the CAVE2™ wand controller if they are close enough to the debris. Additional interaction in the project was implemented by allowing the user to plant milkweeds in the environment using the directional down button on the CAVE2™ wand. Butterflies near the designated area, where the milkweeds can be planted, become animated and start moving when the user chooses to walk close enough. Finally, once the user picks up all of the debris in the lake with the wand controller, the fish in the lake change color from a polluted brown to a healthier water blue and a rainbow descends onto the environment. Describing more of a passive experience, the user is able to look at and hear the birds around them, see the wolves move intermittently, as well as hear the 3D audio of nature and water flowing. As creators of the project, we did our best effort to allow and encourage interaction from the user rather than simply describe the issue.

Discussion

In this paper, we presented the *Earth: Our Future* project addressing the process of creating the Unity VR project itself. The team made sure to design the space in such a way that users were immersed utilizing the 3D audio and 360 degree view[Fig.12] from the CAVE2™ Environment. However, it is important to note the several steps that first preceded the final product. The process of developing the project included steps such as concept design and brainstorming, 3D modeling custom game objects, programming scripts, and assembling the assets together to create the immersive experience with the Unity engine.

A large portion of time was allocated first on brainstorming concepts about the main idea, storyboard[Fig. 4], and effectively tying in the U.N. Sustainable Development Goal of Climate Action. We also spent a considerable amount of time receiving feedback, not just as a group, but as a community. Once sketches were produced, our team then had the vision we needed to move forward in designing prototype scenes and models[Fig. 4]. Usage of tutorials and technical forums were essential in programming the scripts for the project and engineering the project in the Unity environment[Fig.10,11]. Refinement of details came last, such as implementation of sound and a celebratory model after feedback and multiple sessions of testing in the CAVE2™ Environment.

The project took a combination of technical skill in programming, graphic design, organization, and teamwork in learning and using the Unity engine for the first time. As the team of undergraduate students behind the project, we truly believe that our project can serve to increase users' awareness of their direct effect on the environment and that our project raises a call to action for natural conservation to safeguard our future on this planet.

We are thankful for having the opportunity to exhibit *Earth: Our Future* in the CAVE2™ Environment with 50 audience visitors providing feedback and commentary on the project. We are especially grateful for the experience of collaborating with the global IBM Design+Technology+Theater Group in the Electronic Visualization Laboratory (EVL) at the University of Illinois Chicago.

We are excited to see how society progresses toward sustainable development and help society progress in sustainability.

Conclusion

Project *Earth: Our Future* has successfully utilized technology and interactive experiences to address the issue of climate change. The project has shown that immersive educational tools can significantly increase knowledge retention and promote behavioral change. The project has received positive feedback, indicating increased awareness and personal responsibility toward the environment. The interdisciplinary nature of the project has fostered collaboration among experts, resulting in a well-rounded and scientifically accurate representation of ecological challenges. The project aims to expand and reach a wider audience to contribute to the global effort of combating climate change. Ultimately, the project exemplifies the power of technology-driven solutions in addressing pressing issues and empowering individuals to become agents of change.

References

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