Project Breathe

A virtual reality demonstration of Climate Action and a possible solution to mitigate the carbon dioxide in atmosphere

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ABSTRACT

In recent years, the impact of climate change has risen significantly due to the surge of greenhouse gas emissions. It severely affects global ecosystems, economies, and human health. Project Breathe is a Virtual Reality (VR) project that aims to showcase the causes and adverse effects of CO2 emissions and proposes a potential solution: RACTO, an artificial photosynthesis device to help mitigate the impact by reducing CO2 in the atmosphere. Through the interactions with the VR environment, the users can learn about the causes that increase their carbon footprints and explore the concepts of artificial photosynthesis. The project also highlights the major challenges and inspires actions toward overcoming them and bringing this technology to life.

CCS CONCEPTS Human Centered Computing, Environmental Science and Engineering, Human computer interaction.

KEYWORDS

Virtual Reality, Sustainable Development GoalsVirtual reality, Climate change, Artificial photosynthesis, Carbon dioxide, Greenhouse gas emissions.

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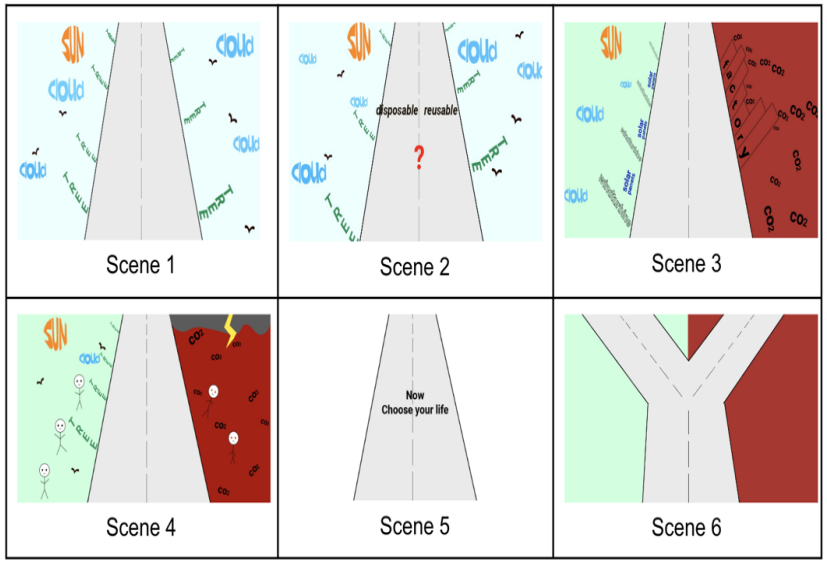

Figure 1: Initial storyboard design focused on dividing into 2 paths and focusing on good and bad raising awareness'

INTRODUCTION

In 2015, as an effort to find a feasible way to solve global issues such as poverty, climate change, inequality, and environmental degradation, the United Nations General Assembly announced the 17 Sustainable Development Goals to the public and inspire people around the world such as designers,computer scientists and students to use their artistic vision and expertise to resolve the world's most challenging problems. Project Breathe addresses the Climate Action development goal that focuses on providing a possible solution for climate change - one of the most critical problems many countries are facing that cause severe problems such as droughts, sea levels rise, and global warming [1] - by reducing the concentration of CO2 in the atmosphere.

This designed solution is delivered more successfully than with a 2D format because of the CAVE2 TM Virtual Environment's distinctive immersive feature with 3d sounds and . Audiences can get together to explore this hypothetical reality as a group. In other situations, virtual reality has been demonstrated to improve teamwork and collaboration, which is essential for developing a sustainable community. This medium allows for unrestricted levels of creativity in depicting how our proposed solution artificial photosynthesis might look and scenes showing the impact of our possible solution on our future.

THE PROBLEM

The greenhouse gas emissions are the principal causes of climate change according to multiple research conducted around the globe., which are tremendously increased since the technological revolution.to the global temperature risen by 1.1 degrees Celcius and the concentration of CO2 in the water bodies by a whooping 30 percent. The statistics show that these changes only occurred in the past 200 years, which is much higher than 50 million years combined. These absurd changes result in abnormal weather patterns and ocean acidification that negatively affect human health and other creatures on Earth. Scientists forecast that the rapid change in pH level in the ocean may cause the extinction of many sea creatures like coral reefs in the following decades. [2] The CO2 concentration has risen from 228 ppm 200 years ago to 410 pm today due to human activities like agriculture, industrialization and transportation.

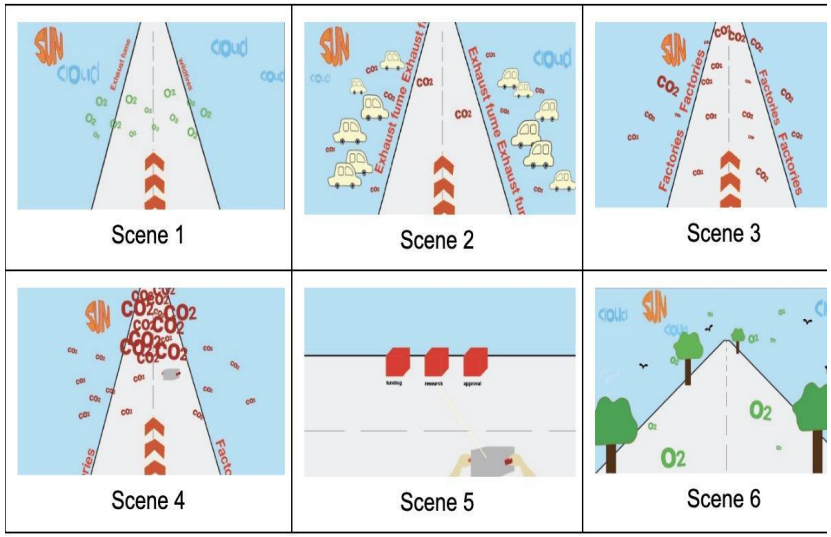

Figure 2: Final storyboard we decided to go with a single path with multiple environmental situations and an artificial photosynthesis device

Figure3: Initial Scene filled with 3d Typography O2

OUR SOLUTION

We started our project with the purpose of explaining about the cynical effects of climate change to our mother nature and as well as our human health (Figure 1). However, this idea did not provide a explicit solution that helps us tackle climate change. During the research process, we found multiple articles about artificial photosynthesis that attempts to mimic the natural photosynthesis process [4] and MOXIE - a device created by NASA to generate O2 from CO2 in Mars [3]. We later came up with an idea about combining these technologies to create a concept device that can help to reduce the CO2 concentration in the atmosphere and propose this device, which we named RACTO (figure 8) as our solution for the Climate Action development goal.

CO2 + Sunlight + Humidity(moisture) ⟶ Oxygen and glucose

VIRTUAL REALITY DEVELOPMENT

To demonstrate the implementation of Project Breathe a possible solution for climate change that's happening around. We developed a virtual reality environment developed through Unity for the CAVE2 environment which would allow users to engage in the smart node installation process. An important aspect of Climate action is encouraging people and creating awareness about what's happening around the world. How pollution is affecting the world and how we can possibly reduce it by utilizing these types of devices in the future . Virtual reality environments can be a formidable tool which lets the user partake and help them visualize complicated concepts in a more fascinating and conjoint way.

By using an immersive virtual reality experience, a user can be encouraged to think about the challenges and long-term benefits of improving their immediate environment.

STORYBOARD DESIGN

We had multiple revisions on the story boards designs based on the thought process and refinement of our project's ideas. The initial design included a path that showed the users two different scenes on the left and right of the path which represented the different outcomes based on users' daily life choices (Figure 1). After multiple iterations of refining the solution,we came up with the last design where we showcased the causes and impact of CO2 emissions are accompanied with our core

Figure 4: 3D Typographic mode of Exhaust Fumes and Pollution animation

Figure 5 : Typography and Animation model of wildfire

solution, RACTO, with its concepts and potentials to reduce CO2 in the atmosphere (Figure 2). We also added a puzzle to this design to let the user explore the challenges of artificial photosynthesis to inspire actions towards overcoming these challenges.

AESTHETIC & INTERACTIONS

The user begins the experience in a virtual environment where everything is filled with oxygen (figure 3). As they walk along the path, they see a large typography image made of exhaust fumes and various vehicles such as cars, bikes, and airplanes, all emitting CO2. A particle system is used to create realistic smoke that slightly obstructs the user's view. (figure 4)

While walking, the user encounters a car passing by, and the sound of vehicles is heard in 3D, making the experience more immersive. As the user progresses, they come across CO2 accumulation caused by the exhaust fumes. These CO2 particles are interactive, and the user can hold and remove them to move forward.

While walking, the user encounters a car passing by, and the sound of vehicles is heard in 3D, making the experience more immersive. As the user progresses, they come across CO2 accumulation caused by the exhaust fumes. These CO2 particles are interactive, and the user can hold and remove them to move forward. At the end of the path, there is a screen showing how exhaust fumes look in real life. The user then walks into a new environment where they encounter a typographic script of a wildfire(figure 5), along with realistic fire animation and an aesthetic forest that's on fire. The CO2 levels increase, and at the end of the path, they become so large that they block the user's path. A screen shows how wildfires look in real life (figure 5)

In order to pass through the path, the user needs to remove all the CO2 particles blocking their way. The CO2 levels increase again as the user walks towards the next environment, where they encounter typographic script of factories and 3D factory sounds. The CO2 levels become even larger, and there are aesthetic real-world factories with realistic black smoke coming out of them. At the end of the factories, a screen shows factories and the pollution they cause. (figure 6)

Now, the CO2 levels are so high that the user cannot move forward. To their left, there are three red cubes with approval, research, and funding written on them, along with 3D typography words like research, approval, and funding in front of them.

Figure 6: The user walking through factories co2 and giant CO2 blocking the users path

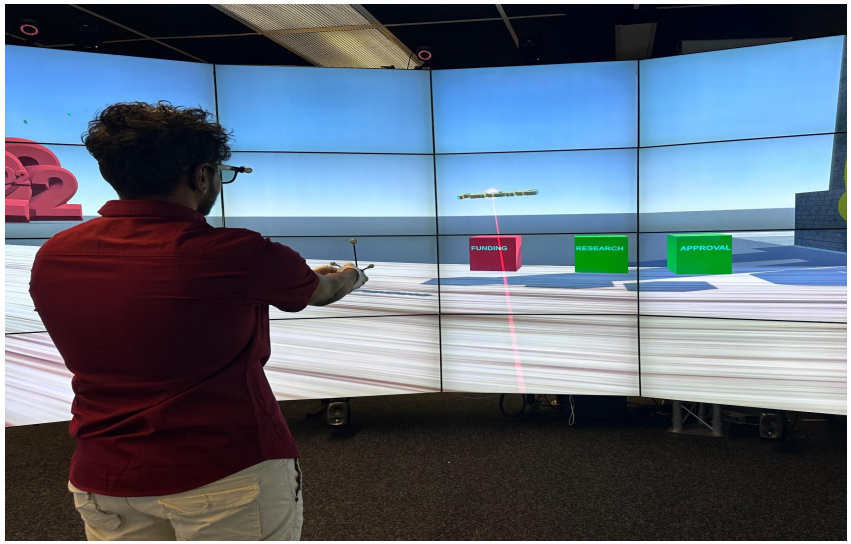

Figure 7: The user interacts with puzzle with approval, funding typography to reveal the Device

The user picks up the cubes using the Cave 2 controller and interact with them. When the user touches the approval typographic text on the cube, the cube turns green, and the same happens with the research and funding cubes.(figure 7) After all three cubes turn green, a device and two screens appear from the ground, explaining about the device and its functionality.

The device is called **RACTO** (Revitalizing Carbon to Oxygen Conversion) and uses artificial photosynthesis to convert CO2 into O2 (figure 8). The RACTO device has a sleek black design, which not only looks aesthetically pleasing but also serves a functional purpose. Black is an excellent absorber of sunlight, which is needed to power the artificial photosynthesis process within the device(figure 9).When the user presses the button on the device, the CO2 explodes and changes into O2 with a 3D explosion sound. Now, the user is free to walk the path without any blocking (figure10).

After all the CO2 is gone, the user walks a bit more and encounters greenery, trees with lots of O2, and peacefulness. After walking for a while and admiring the beautiful surroundings, the user sees a screen with the title "Project Breath - Made to Save Our Earth," (figure 11) indicating that the experience has ended.

CODING AND INTERACTIVE EXPERIENCES

Our team members had little experience with scripting in C#, so there was a deep learning curve at the beginning of the project. Fortunately, we could overcome all the challenges with the help of the EVL team and their great materials and guidance. We built our project upon the “omicron-unity CAVE2 Simulator” provided by the EVL team. The template provided basic scripts for the controllers and camera settings for use in the CAVE2 environment. To make the objects in our scenes interactive, we attach C# scripts to Unity scene objects and trigger the event handlers using the provided controls such as laser pointing and dragging. The most challenging part of our project was the puzzle we had at the end of the path that was blocked by a CO2 wall (Figure 5). This interaction required a lot of effort to debug because we could not get the colliders scripts to work correctly.

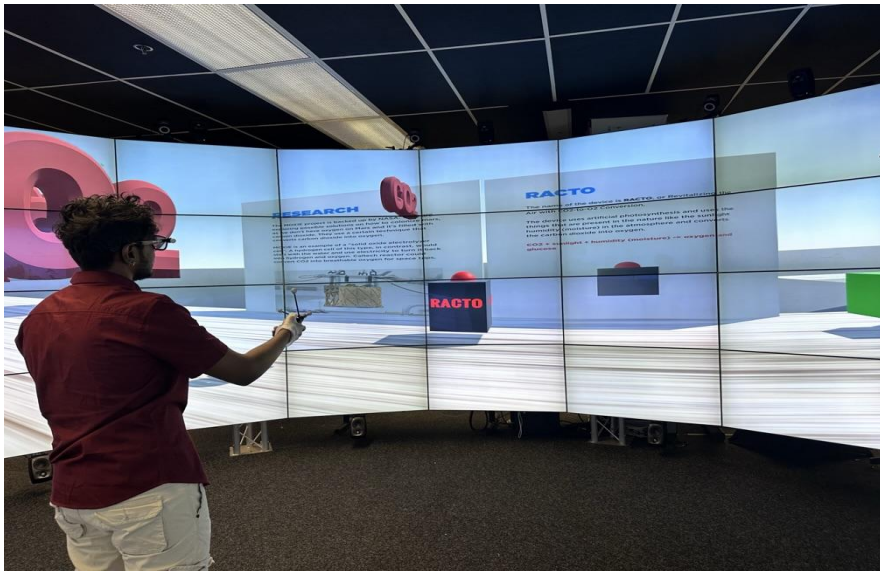

Figure 8: Information about RACTO and how it works

Figure 9: Before the user interacted with RACTO we can see the large amount of co2 gathered which cannot be movable with device blocking the users path

AUDITORY EXPERIENCE

The Project Breathe VR project provides users an auditory experience that complements with the visual elements of the VR environment. Sound effects that we used will help the user to get a more immersive experience in the different levels of the project, with each level representing a different source of CO2 emissions. We used different kinds of sound effects for different levels such as the sounds of vehicles representing exhaust fumes and sound of fire to represent wildfire. And the sound of factories is used to represent factories . The use of sound effects adds a layer of real world feeling to the VR environment, making it more pleasant and impactful for users.

In addition to the other sound effects , Our project includes a unique sound effect specifically for the RACTO device, which is the artificial photosynthesis solution proposed to mitigate the impact of CO2 emissions. The sound of a while interacting with the device, creating a sense of accomplishment for users is this subtle sound of explosion that destroys Co2 and fills the atmosphere with 02 . We also fused 3D sound effects with the visual elements of the VR environment which adds to the overall mesmerizing experience, making it an constructive tool to stimulate awareness and motivate to partake action towards climate change.

LIMITATIONS AND CHALLENGES

One of the major challenges in developing artificial photosynthesis is improving the sunlight capturing and converting into usable energies. This improvement requires innovative materials and technologies that can efficiently capture and convert sunlight into chemical energy [6]. Another challenge is finding stable and cost-effective catalysts for the reaction. These catalysts should facilitate the chemical reaction at a reasonable rate with low energy input requirements [7]. Finally, it is also a significant challenge to integrate artificial photosynthesis to the existing infrastructure. The development of new infrastructures to store, transport and distribute the materials, products and energy produced by artificial photosynthesis are also required for bringing this technology to life.

CONCLUSION

The Project Breathe VR project demonstrates the potential of technology, specifically virtual reality and artificial photosynthesis, in raising public awareness and promoting action towards mitigating the negative effects of climate change. The project showcased the negative effects of CO2 emissions

Figure 10: After using RACTO and converting CO2 into O2

Figure 11: Showing the ending scene with title “Projet Breathe Made to save our Earth”

and proposed a solution to mitigate the impact by reducing CO2 levels in the air. The proposed solution, RACTO, is an artificial photosynthesis device, and ongoing research in this field aims to convert atmospheric carbon dioxide into oxygen.

Through a collaboration between the global IBM Design+Technology+Theater Group and the Electronic Visualization Laboratory (EVL) at the University of Illinois Chicago, the Project Breathe VR project was developed, highlighting the importance of industry-academia partnerships in addressing global issues such as climate change.highlighting the potential of technology to promote accessibility and inclusivity in climate change awareness efforts.

The Project Breathe VR project was exhibited in the CAVE2 in EVL/UIC, showcasing the potential of virtual reality in promoting awareness and understanding of complex issues such as climate change. The project was also live streamed, allowing a wider audience to view the project and engage with its message. The live stream feature enabled viewers from different parts of the world to experience the project remotely.

The exhibition of the Project Breathe VR project was viewed by 50 visitors who provided feedback and comments about the project design and exhibition. Their feedback highlighted the effectiveness of the project in raising awareness and inspiring action towards climate change. Overall, the Project Breathe VR project highlights the importance of addressing climate change and the role of technology in finding solutions. Through its use of virtual reality and artificial photosynthesis, the project encourages individuals to take concrete actions in contributing towards a sustainable future for the planet.

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