

City Improvement Movement

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The City Improvement Movement is an immersive virtual reality project that aims to encourage individuals to actively participate in the efforts to create sustainable cities. People need to be aware of how easy it is to act; this VR experience introduces the user to achievable solutions. Our goal with this project is to inspire people and give a sense of responsibility for our cities by addressing topics like air pollution, greenhouse gas emissions, energy efficiency, and climate change. The City Improvement Movement project was created together with the global IBM Design + Technology + Theater Group, this project was created in the Electronic Visualization Library (EVL) at the University of Illinois Chicago (UIC) to fully utilize the CAVE2™ Virtual Environment along with Unity and C-sharp.

CCS CONCEPTS • Human-Centered Computing, Environmental Science and Engineering, Human-Computer Interaction.

Additional Keywords and Phrases: Sustainability, Virtual Reality, Climate Change, Infrastructure, Energy Efficiency

INTRODUCTION

In our rapidly urbanizing world, the need for cities to become sustainable has never been more pressing. Cities generate a significant share of the world's environmental challenges. With over half of the global population now residing in urban areas, addressing these challenges is crucial for the well-being of both current and future generations. Urban areas are major contributors to climate change, with their high energy consumption, transportation emissions, and concentration of industrial activities. Pollution and overconsumption of resources further strain the environment. Sustainable cities focus on reducing carbon emissions, adopting renewable energy sources, improving public transportation, and implementing green infrastructure to mitigate these impacts. Doing so, they play a vital role in global efforts to combat climate change.

How can our actions affect our cities for the better? The City Improvement Movement is an immersive virtual reality project that aims to encourage individuals to actively participate in the efforts to create sustainable cities. Many underestimate how much of an impact their actions can have on urban communities. People need to be aware of how easy it is to act. This virtual reality experience introduces the user to achievable solutions. It aims to inspire people and give a sense of responsibility for our cities by addressing topics like air pollution, greenhouse gas emissions, energy efficiency, and climate change.

THE PROBLEM

In our rapidly urbanizing world, the need for cities to become sustainable has never been more pressing. Cities generate a significant share of the world's environmental challenges. Urban areas are major contributors to climate change, with their high energy consumption, transportation emissions, and concentration of industrial activities. Pollution and overconsumption of resources further strain the environment. Sustainable cities focus on reducing carbon emissions, adopting renewable energy sources, improving public transportation, and implementing green infrastructure to mitigate

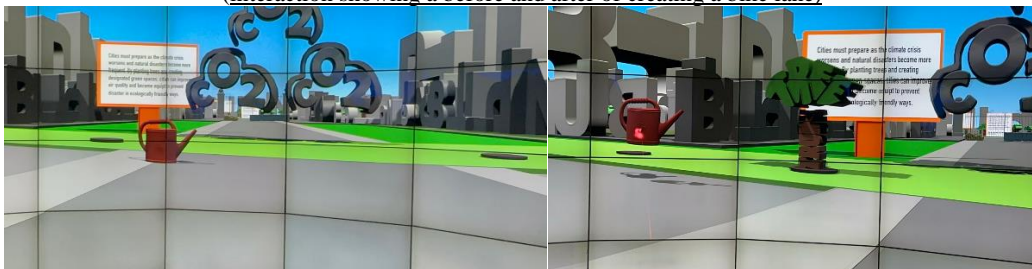
these impacts. Doing so, they play a vital role in global efforts to combat climate change. Sustainability in cities is also linked to social and economic factors. A well-planned sustainable city can enhance the quality of life for its residents. Clean air, efficient transportation, green spaces, and affordable housing contribute to a healthier and happier population. Sustainability initiatives create jobs and encourage economic growth, as investments in renewable energy, energy efficiency, and sustainable transportation systems generate economic opportunities. With over half of the global population now residing in urban areas, addressing these challenges is crucial for the well-being of both current and future generations.

INTERACTIONS

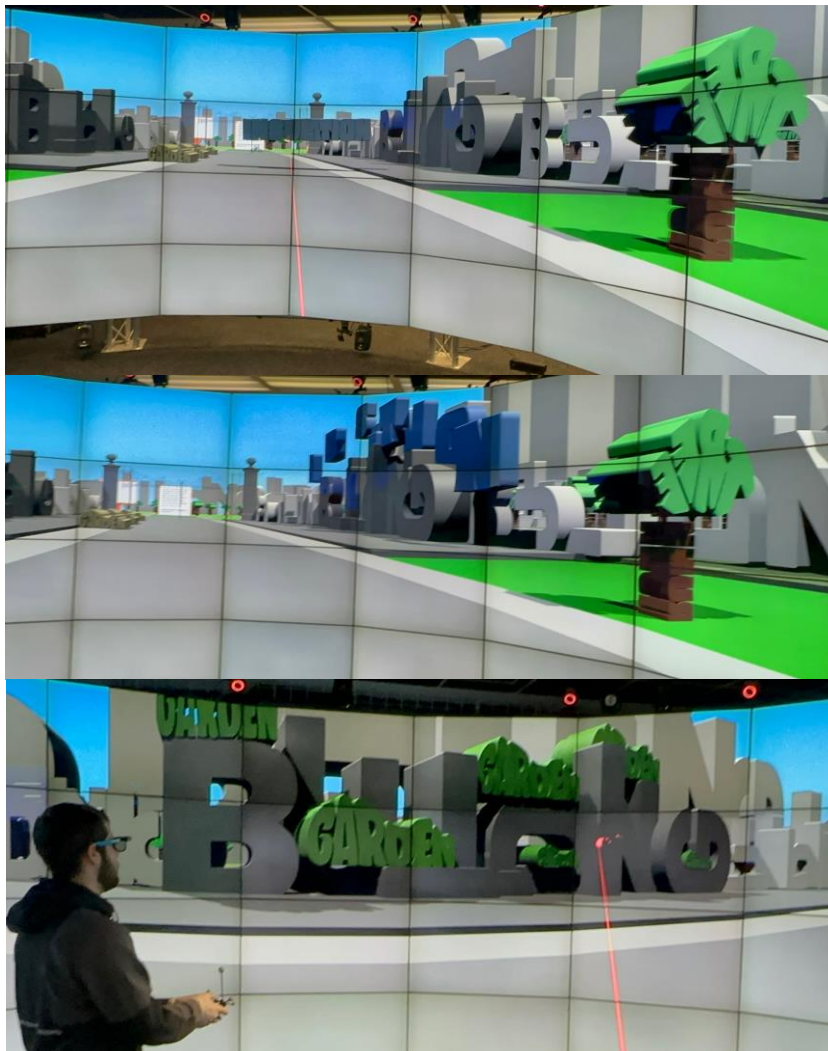
In the immersive world of the "City Improvement Movement" VR experience, users engage in interactions that symbolize real-world urban challenges and sustainable solutions. The journey begins with the user confronting heavy traffic. To disperse traffic, the user must "pick-up" a provided spray can that is spawned next to them. The spray can is ideally supposed to spray green particles representing paint and if the user were to walk onto the traffic with the paint particles, a bike lane would appear, and traffic would decrease. Moving forward, users encounter polluted air represented by CO2 clouds and dirt circles. To clear the CO2 a user must interact with a provided water can nearby. The user can pick up the water can and walk towards the dirt circles. Once the water and dirt interact a tree would appear. If all dirt circles are interacted with, the CO2 clouds would disappear. Further into the virtual cityscape, users encounter two typography objects ("garden" and "insulation") near 2 specific buildings. The user can grab the said objects and build them on top of the said buildings unlocking transformations that symbolize the power of green spaces and energy-efficient infrastructure. These interactive elements serve as both metaphors for real-world challenges and tools for users to actively contribute to the positive evolution of the urban environment. Throughout the whole process, the user would notice that the world begins to become much livelier as more trees begin to grow, birds appear, and moving bikes zoom around.



(interaction showing a before and after of creating a bike lane)



(before and after of growing tree interaction)



(demonstration of the building interaction where you had to install insulation and a green rooftop)

SCRIPTING

Perhaps the most challenging part about this project was coding. It makes it even more difficult since for most of us, it is our very first-time using Unity (the program where we created our project). While our amazing professors and TA taught us the basics, we had to go beyond what we learned in order bring our ideas to life. One of our most proud works is our second event interaction. It involves a user to water dirt holes and from there a tree would grow in front of them in a life-like animation. Growing enough trees would allow to remove a blocked path that prevents them from progressing further. The work behind this required extra research on how objects interacted with scripting inside Unity and creativity. The first step of our process was to create some sort of “tree tracker,” we needed a way for Unity to track the number of trees grown so it knows when the clear our path. From there we create a script for the tree itself, it would make our tree

object start out as invisible until “water” has been interacted with it. Then, the tree would reappear in a small state but suddenly grow into a normal sized tree.

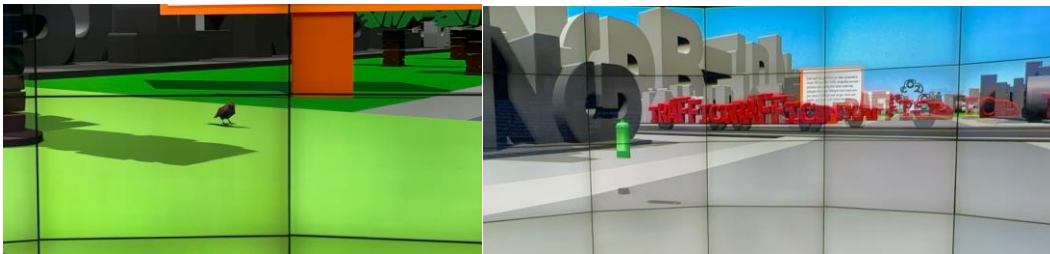
```
private void Update()
{
    if (isGrowing)
    {
        // Gradually increase the scale
        transform.localScale = Vector3.Lerp(transform.localScale, targetScale, Time.deltaTime * growthSpeed);

        // Once it's close to the target scale, make it fully visible
        if (Vector3.Distance(transform.localScale, targetScale) < 0.01f)
        {
            transform.localScale = targetScale;
            isGrowing = false;
        }
    }
}
```

(small snip of code related to tree growing)

AUDIO

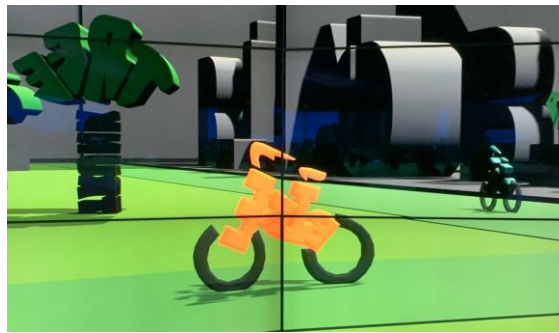
Another challenge our team had to face was making our environment feel more “life like” as animated objects is not enough. So, adding audio throughout the environment was a key interaction we had to pay attention to. All of our objects that are interactable have some sort of animation, the goal was to make the actions the user take feel more realistic but at the same time we didn’t want to overdo it with the sound effects. Not only that, but we also added audio towards objects that are considered “background decoration”. For example, throughout the VR experience, birds would appear. If the user were to walk towards one, a chirp sound effect would take effect. Other passive audio would include cars, bikes, and even user audio such as coughing.



(objects such as this bird and zooming traffic have their own unique audio that brings the environment to life)

TYPOGRAPHY

Typography plays a central role in the "City Improvement Movement" VR experience, where symbolic elements are crafted from text to convey powerful messages. As users navigate the virtual city, buildings and objects are constructed with typography, creating a visual language that adds a unique aesthetic dimension to the environment. Notably, the interactions strategically involve typography objects to prompt transformations, visually reinforcing the significance of creating sustainable urban environments. This intentional integration of typography not only serves as a visual identifier but also enhances the overall narrative, turning ordinary structures into meaningful symbols that underscore the project's core message of individual actions shaping positive urban futures.



(we use typography to design objects such as the trees, bikes, and buildings)

STORYBOARD

During the creative process, a storyboard was required since we needed to have some sort of ideal goal to create. We put a lot of thought into ours and while we had many ideas, we were only limited to map out our creation with a limit of 6 pictures. Provided by the image below, we can see our storyboard. In the first picture we have a drawing of what the general map design of what players are going to see once entering the VR. The second picture shows our first interaction which includes shoveling the ground to plant trees. The third picture shows an improved version of picture 1, this was to express the idea of the environment around the user slowly improve as more actions are done. The fourth and fifth picture shows an interaction between tools that results in creating a building with a green roof top. Finally, the last picture shows an interaction dealing with flooding.

This storyboard was created all the way back around early September, by the time we completed the City Improvement Movement in late November we had made some different design changes. For example, the shovel you see on the second and last slide has been scrapped and instead replaced with a water can to plant trees. The tool interaction to create buildings has been altered, instead of creating a building with a green rooftop, we install a green rooftop to an existing building. The flooding interaction that you see has been completely scrapped and replaced with a bike lane building interaction instead. While our final product may not match our initial storyboard, it has still played an important role in helping to guide us to create our project in the right direction.



(original storyboard of our project)

CHALLENGES

Creating the "City Improvement Movement" VR project potentially brings various challenges. First, ensuring a seamless and immersive user experience requires careful consideration of user interface design, navigation, and the overall flow of interactions. Technical challenges may also arise in implementing the VR project into the CAVE 2 system so considering the limits of what the user can do is another. Collaborating with a team, particularly with communication and coordination is something we must always consider, so creating effective project management strategies becomes a problem. Additionally, optimizing the project for performance, especially in resource-intensive VR environments, could be a concern. Lastly, addressing accessibility considerations and ensuring that the VR experience is inclusive and user-friendly for individuals with varying abilities may present a design challenge.

OUR SOLUTION

Updating current infrastructure and city planning in a world where natural disasters and pandemics are becoming more frequent and severe is crucial. Sustainable practices, such as building resilient infrastructure and conserving resources, reduce vulnerability to extreme events and ensure that cities can continue functioning when faced with adversity. Sustainability in cities is a necessity for the well-being of urban populations, the preservation of our planet, and the advancement of society. Through sustainable urban planning, innovative technologies, and community engagement, cities can transition towards a future where they provide a high quality of life for their residents and future generations.

The City Improvement Movement takes the user into a virtual city where you are free to explore. However, as the user moves forward, problems with the city's environment and infrastructure will become more apparent. These issues, including traffic congestion, pollution, lack of green spaces, and inefficient insulation of buildings, will prevent the user from progressing forward in the experience. This is when the user must interact with the environment in order to bring change. Doing so clears obstacles and allows the user to explore the city even further. As more change is done, the field will become livelier and more sustainable. This reflects what could happen if we were to bring environmental change into real cities throughout the world.



(image of the whole team admiring the hard work we have accomplished)

CREDIT TOWARDS 3D Modelers

We'd like to give a special thank you to all the 3D artists that have helped contributed to our work. This includes 3D models such as the birds and texture packs such as the sky. Artists who give out their work for free are much appreciated and have helped students like us enjoy creating wonderful projects.

Credit:

'AllSky Free - 10 Sky / Skybox Set'

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'Ground 037' & 'Grass 001'

<https://ambientcg.com/view?id=Ground037> | <https://ambientcg.com/view?id=Grass001>

'New Road Materials'

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'brown concrete building during daytime'

Clark Van Der Beken

<https://unsplash.com/@snapsbyclark>

'Facade 009' & 'Facade 006'

<https://ambientcg.com/view?id=Facade009> | <https://ambientcg.com/view?id=Facade006>

'Spray Can'

beyondmatter

<https://sketchfab.com/3d-models/spray-can-24f0c5db0f4548f09bbdc57cc61a4353>

'Watering Can'

3Dog

<https://sketchfab.com/3d-models/watering-can-c0d71ad2adae42aa9b06a689a335c007>

'Luxury Gate'

Jeff Meunier

<https://sketchfab.com/3d-models/luxury-gate-3b9e5f3023a64ebc9bc51fdcb28f6309>

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