

# FROM WASTE TO WONDERS

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## 1 ABSTRACT

From Waste To Wonders is a virtual reality (VR) project developed through the Creative Coding course at the University of Illinois Chicago, in collaboration with the IBM Design+Technology+Theater Group. Created using the Design+Theater+Coding methodology and exhibited in the CAVE2 Virtual Reality Environment at the Electronic Visualization Laboratory (EVL), this interdisciplinary project addresses the United Nations Sustainable Development Goal (SDG) 12: Responsible Consumption and Production. Grounded in research demonstrating VR's effectiveness in fostering empathy and pro-environmental behavior, the experience uses immersive storytelling, typography-driven design, and interactive gamification to engage users in a composting journey. By embedding real-world data, such as Chicago's compost drop-off locations, the project transforms abstract sustainability challenges into a localized, actionable experience—promoting awareness of food waste and encouraging sustainable practices in urban environments.

## 1.1 AUTHOR KEYWORDS

Immersive Design; Sustainability Education; Environmental Interaction; Typography; Improvisation; CAVE2

## 1.2 ACM CCS KEYWORDS

Human-centered computing → Virtual reality; Computing methodologies → Mixed / augmented reality

## 2 INTRODUCTION

Food waste is one of the leading contributors to climate change, affecting global greenhouse gas emissions, resource efficiency, and food security. Approximately one-third of all food produced globally is lost or wasted, and 10% of greenhouse gas emissions are attributed to this issue [3]. Urban residents, including those in Chicago, often treat food scraps as landfill-bound trash, overlooking local composting opportunities [4].

From Waste to Wonders tackles this problem by transforming compost education into an interactive VR experience developed in CAVE2 at UIC. The project uses experiential learning to help users understand what composting is, why it matters, and how it connects to daily behavior. Grounded in environmental communication and behavioral science, it reimagines sustainability as an accessible and actionable goal [5][6].

## 3 RESEARCH & BACKGROUND

Virtual reality is increasingly recognized as a powerful tool in environmental education for its ability to communicate complex issues through embodied and engaging experiences [6][7]. Unlike traditional learning methods, VR fosters empathy and promotes behavior change by immersing users in realistic, interactive environments [5]. At Stanford, researchers found that experiencing environmental challenges such as ocean acidification through VR significantly boosted empathy and understanding of sustainability topics [6]. Similar studies in agriculture show that VR outperforms traditional video-based tools in teaching composting and encouraging pro-environmental behavior [8]. From Waste to Wonders builds on this foundation by addressing Sustainable Development Goal 12: Responsible Consumption and Production [3]. This SDG emphasizes reducing food waste, improving recycling and composting practices, and raising awareness about sustainable living. In urban areas like Chicago, where food scraps often end up in landfills, awareness is essential. Although the city offers more than 20 food scrap drop-off sites [4], many residents are unaware they exist. Our project bridges this gap by embedding real composting data and city maps into an immersive VR environment that transforms passive learning into active engagement.

Central to this design is the CAVE2 system—a 320-degree cylindrical display environment featuring 88 passive stereo off-axis-optimized 3D LCD panels, a 14-camera optical tracking system, and spatialized surround sound [1]. Unlike individual headsets, CAVE2 supports group-based learning and discussion, making it an ideal platform for public exhibitions and collaborative education.

## 4 VIRTUAL REALITY DESIGN PROCESS

Our team followed the Design+Theater+Coding methodology from UIC's Creative Coding course [2]. Rooted in interaction design and theatrical improvisation, this approach supports iterative, scene-based storytelling tied to behavioral outcomes. Initial concepts explored metaphorical designs, but through improv exercises and feedback, we pivoted to a grounded structure with four modular scenes. Developed in Unity with C#, visual assets were created using Maya, Illustrator, and Audacity. Our team used Box for collaborative asset sharing and version control. The project was exported to the CAVE2 Virtual Reality Environment using the CAVE2 Unity Template, which integrates the Omicron framework and GetReal3D plugin to enable real-time user interaction and spatial tracking. This process was completed with technical support provided by the Electronic Visualization Laboratory (EVL).

The four scenes were:

- Smelly Kitchen: Introducing the user to food waste.
- Trash-Filled Street: Illustrating pollution and low composting infrastructure.
- Compost Facility: Showing food-to-soil transformation.
- Tomato Farm: Visualizing regrowth and user interaction.

Each scene represents a stage in the cycle of waste to renewal, supporting SDG 12 goals of education, awareness, and resource efficiency.



Figure 1: Dirty kitchen



Figure 2: Trash-filled street

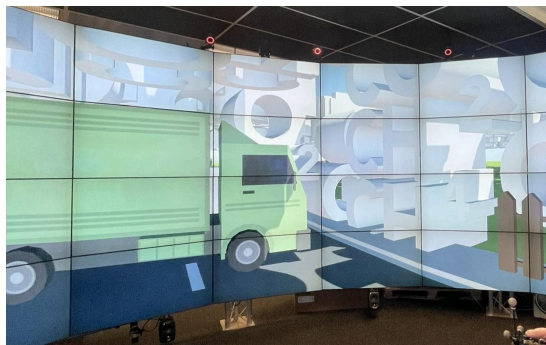


Figure 3: Compost truck & greenhouse gases



Figure 4: Ending scene at the farm

## 5 TYPOGRAPHY DESIGN PROCESS

Typography formed the foundation of our visual language. Instead of standard 3D objects, elements were constructed from words—tying linguistic identity to form and meaning. Words like “banana”, “eggshell”, “cabbage”, “CO<sub>2</sub>”, “CH<sub>4</sub>”, “plant,” “tree,” and “nutrient-rich soil” were shaped in Maya, stylized in Illustrator, and animated in Unity. The leading typeface was Avenir, chosen for its readability and modern aesthetic, reinforcing clarity in environmental messaging. Nature elements used CFTreeOfLife, a stylized font that emphasized organic texture and contrast with built environments. This design choice visually emphasized our SDG: repurposing discarded items into educational tools, much like compost itself.

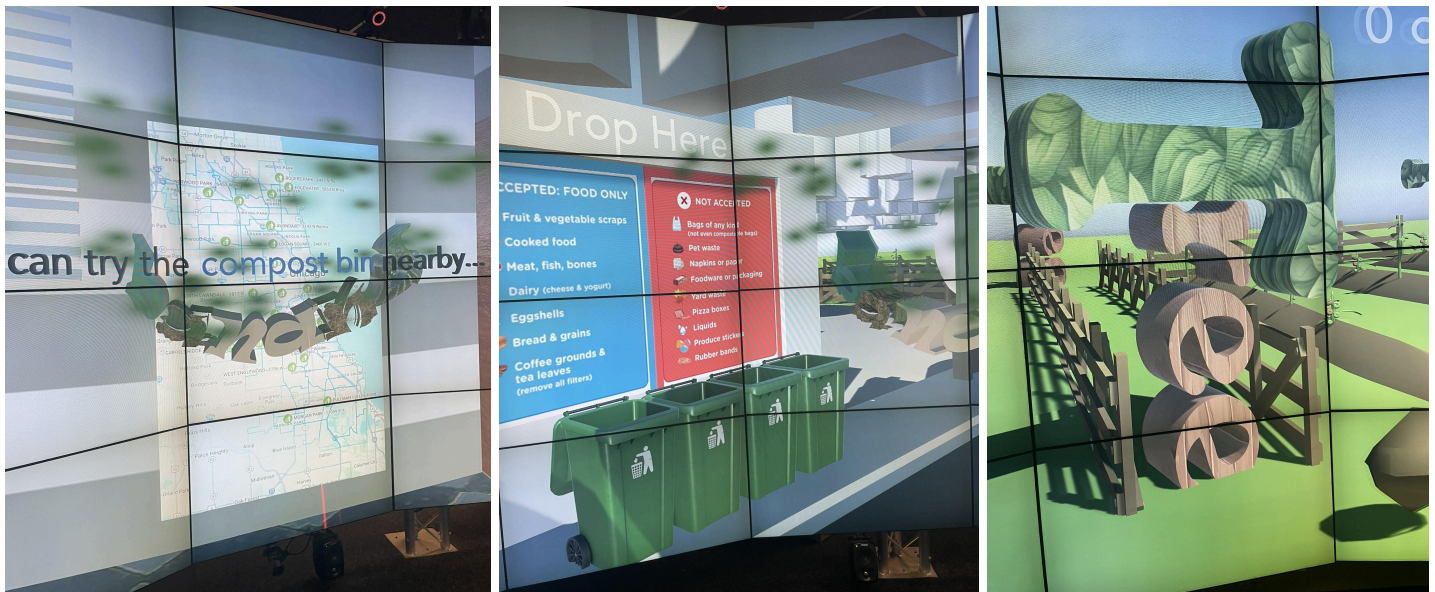


Figure 5: Examples of typography in the project

## 6 ITERATIVE TESTING AND REFINEMENT

Our project underwent two rounds of testing in the CAVE2, which directly influenced several key changes:

- **Kitchen Scaling:** The original kitchen felt too small relative to the player’s height. We enlarged it for better immersion.
- **Item Flexibility:** Initially, only a banana allowed the user to progress. We expanded functionality so that any food scrap could be used.
- **Gameplay Length:** Feedback revealed that the experience was too short, so we added a compost scavenger mechanic on the farm scene.
- **Movement & Clarity:** Navigation speed and object size were adjusted. Clearer visual and text cues were added to guide interaction.

These refinements helped balance storytelling with usability and improved both flow and engagement.

## 7 VR EXHIBITION / RESULTS

“From Waste to Wonders” was showcased in the CAVE2 to an audience of over 50 visitors. Participants highlighted the clarity of the composting message, the engaging use of typography, and the intuitive nature of the game-like interactions. Many commented that they were unaware of compost drop-offs in their neighborhoods and left with a renewed interest in sustainable practices. By blending art, design, and environmental education, the exhibition sparked honest conversations about waste and responsibility—demonstrating the power of immersive storytelling in public outreach.

## 8 CONCLUSION

From Waste to Wonders demonstrates how virtual reality can convert environmental education into a multisensory, interactive, and memorable experience. Developed through UIC’s Creative Coding course using the Design+Theater+Coding methodology, it empowers users to view composting not as an abstract ideal but as a practical, local action. The project specifically seeks to inform residents of Illinois—particularly those in Chicago—about composting resources and inspire sustainable behavior by making the learning experience personal and place-based. During the exhibition, many participants expressed surprise, saying things like “I didn’t know composting was an option here,” highlighting the project’s potential to shift public perception. By embedding typographic storytelling, real-world data, and hands-on interaction in the immersive space of the CAVE2, this project offers a scalable model for teaching SDG 12 goals and sparking environmental awareness through creative technology.



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