

Industrial Lichen: Exploring the Intersection of Nature, Industry, and Technology

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Abstract

“Industrial Lichen” prompts attention to the impact of industrialization and environmental sustainability on human life through an immersive experience, a profound reflection on the ecological changes between industrialization and nature. It provides a space for experimentation and reflection. The work invites the viewer to enter a virtual space where the viewer can observe and feel more deeply the concepts of time and environmental evolution conveyed by the work. And how we can live in harmony with nature in a rapidly evolving technological age. By providing an immersive environment at the STYLY platform, the interaction between the viewer and the art is enhanced. This approach emphasizes WebVR’s potential to deepen understanding of our role in advocating for the protection of the environment and sustainable development. In “Industrial Lichen”, WebVR makes it possible to deepen the connection with the viewer, encouraging them to think about the role of human beings in the natural world and how our actions have influenced the past, present, and future.

Keywords

WebVR, Interactive Art, Digital Media, Environmental protection, Sustainability

Introduction

Sustainability and environmental protection have become urgent global issues in the rapidly evolving modern context. The term “sustainability” is widely applied in agricultural production [7], industry [9], and urban development [12], and has become the conceptual foundation of theoretical approaches such as circular economy [11]. It has become part of the common sense of most of the world’s population and a political slogan for environmental protection [10]. With the acceleration of industrialization, human exploitation and utilization of natural resources have reached unprecedented levels, leading to resource depletion, severe environmental pollution, and ecological destruction. The worsening of climate change, loss of biodiversity, land degradation, and deterioration of air and water quality are undeniable side effects of industrialization. These environmental issues not only threaten the health of our planet but also pose significant challenges to the future development of human society. In the face of these environmental issues, the global community has increasingly recognized the importance of sustainable development. Seek-

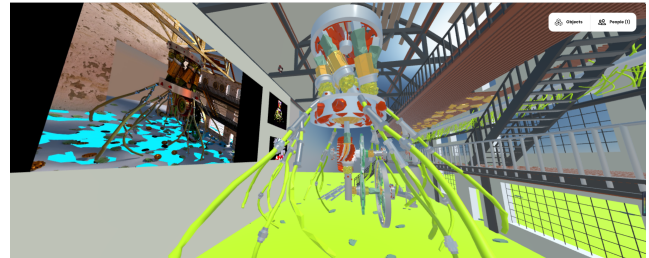


Figure 1: The Display of Industrial Lichen in WebVR.
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ing a balance between economic growth, social inclusion, and environmental protection has become urgent.

WebVR technology creates a multi-layered experiential space that transports the audience into a virtual world co-constructed by nature and industry, offering us new pathways to understand and address major contemporary issues [13?]. It broadens the audience for art and provides a fresh perspective to reveal our environmental issues and sustainability challenges. By leveraging WebVR and immersive experiences [6], “Industrial Lichen” offers audiences a virtual artificial world where lichens symbolize nature’s resilience and recuperative power while reflecting the profound impact of human activities on the environment. The growth and changes of lichens are indicators of ecological health and mediums for telling stories about the relationship between humans and nature. In this virtual environment, the audience can feel the subtle changes in the natural world and the impact of human activities. In this way, “Industrial Lichen” is an artistic expression and a social practice, encouraging the audience to think about how to act and contribute to a more harmonious relationship between human activities and nature (see Figure 1).

On the other hand, “Industrial Lichen” demonstrates how art and technology can join forces, challenging our traditional understanding of aesthetics and, more importantly, redefining the role and significance of art in social transformation. Through such exploration, “Industrial Lichen” contributes to the discourse on sustainable development and environmental protection and boldly anticipates future artistic creation and social action possibilities.

Project Description

“Industrial Lichen” selects lichens and industrial parts as its primary creative elements, reflecting the environmental changes between industrialization and nature. Lichens are symbiotic entities composed of fungi and photosynthetic organisms, usually algae or cyanobacteria [8]. They exhibit diversity in form and structure, categorized into three main types: foliose, fruticose, and crustose lichens. Foliose lichens resemble leaves; fruticose lichens are bushy; crustose lichens cling tightly to the surface they grow on, appearing like thin crusts or spots (see Figure 2). In the biosphere, though unassuming, lichens are an essential component. They can grow in extreme environments but are also very sensitive to environmental changes, often used as indicators of ecological health.

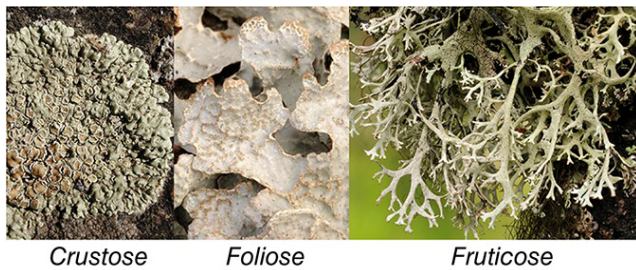


Figure 2: Three Lichen Types. ©Credit by Einar Tindal.

Additionally, they contribute to ecosystems in various ways, including aiding soil formation, providing habitats and food sources, and participating in the nitrogen cycle [2]. The choice of lichens is not only due to their unique ecological indicator function but also to symbolize the fragility and resilience of nature. Through such artistic creation, we hope to promote widespread recognition of the importance of sustainable development and environmental protection. We encourage actions across society to strive for a harmonious coexistence between humans and nature.

By integrating lichens with mechanical parts, “Industrial Lichen” creates a complex three-dimensional mechanical structure, symbolizing the fusion and opposition between the natural world and industrialization (see Figure 3). In this work, lichens are raw elements and environmental indicators, showcasing the impact of machinery and industrialization on the ecosystem.

“Industrial Lichen” sets in an abandoned factory environment, which, over time, gradually recovers and becomes vibrant with the growth of lichens (see Figure 4). Here, the machinery structures covered with natural lichens represent the remnants of industrialization as well as the resilience of nature after human intervention. This visual contrast emphasizes the tension between human activities and the natural world, alerting the importance of environmental protection and sustainable development and expressing deep contemplation of the relationships between time, nature, and technology.



Figure 3: The Industrial Lichen: Parts and Components. ©Credit by Authors.

Related Works

“This is Climate Change” employs a series of four short 360° VR films—Fire, Famine, Feast, and Melting Ice—to vividly depict the multifaceted impacts of climate change on our planet. The creators, Participant Media and Condition One, present a direct window into the diverse ways human activities contribute to global climate alterations. These films encapsulate the severity of climate change through distinct thematic focuses and serve to educate and engage a wider audience by placing them while unfolding environmental crises. This project creates an immersive experience that effectively magnifies the impact of films, providing poignant insights that could drive viewers towards more environmentally conscious decisions [5].

Chandler et al.’s study leverage VR technology and 3D modelling to create immersive experiences of an Australian ecosystem, aiming to deepen understanding of ecological variability and responses to environmental changes. This virtual environment, complete with seasonal plant animations



Figure 4: The Industrial Lichen rendered by Octane. ©Credit by Authors.

and varying soundscapes, was evaluated by experts for its educational and engagement potential. Found believable by 88% of participants, it illustrates VR's capacity to enhance environmental conservation efforts. For artists, this presents an opportunity to engage audiences with nature, potentially raising awareness for environmental protection and sustainable development through vividly simulated ecosystems[4].

The study by Priska Breves and Vivien Heber explored how immersive 360° nature videos impact environmental commitment. Using an experimental approach with 56 participants, they compared the effects of these immersive videos against traditional nature videos on spatial presence and ecological connectedness. The results showed that immersive videos led to a stronger sense of spatial presence and a higher commitment to the environment. Additionally, the "need for effect" was examined as a potential moderator, revealing that immersive videos significantly impacted those with lower levels of this trait [3]. This study suggests that integrating immersive and virtual reality elements in art could enhance audience engagement with environmental themes, potentially fostering deeper connections to nature and promoting pro-environmental attitudes.

By drawing viewers into a virtual world that vividly juxtaposes nature with industrial influences, WebVR and immersive experiences present a powerful tool for raising awareness and motivating change in how we interact with our planet, impacting how audiences engage with environmental protection and sustainable development. They foster an understanding and emotional connection to ecological issues. Many installations limit exploration and interaction within virtual environments, reducing the audience's immersive feeling. Moreover, most Web VR and immersive experiences are still based on real-world landscape experiences. Combining artistic expression with physical realities promises to spark a better audience's consideration of how people coexist with nature. Our project aims to create an immersive experience for users through Web VR, guiding them to contemplate sustainable development and harmonious human-nature interactions further.

Technical Realization and Interactive Process

"Industrial Lichen" harnessed Cinema 4D R23 and OctaneRender For Cinema 4D 2021.1-(R2) to craft detailed 3D models, applying Subdivision Surface Modeling and Parametric Design for precision. The rendering leaned on Octane's spectral capabilities with physical lighting, Ambient Occlusion, and Global Illumination enhancing the scenes. AI analysis shaped the lichen models by extracting essential visual traits, setting the foundation for a narrative enriched with vivid colours and realistic lighting. Advanced rendering adjustments and GPU acceleration were crucial to ensure realism and performance. The design emphasized interactive and dynamic views, offering an immersive experience bolstered by high-resolution visuals, advanced ray tracing, and a user-friendly interface. This approach highlighted the project's unique visual appeal and optimized the audience's engagement.

Regarding the sound element, it was crafted using Google's MusicLM, which synthesizes a unique soundscape by interpreting keywords aligned with themes of eco-friendliness, the fusion of biology and industry, white noise, and the sonic environment of industrial settings. This process allows MusicLM to enhance the art, offering a richer and more immersive auditory experience that mirrors the complexity and diversity of the themes at play. The resulting soundscape adds nuanced layers to the artwork's narrative, enhancing its depth and complexity[1].

Initially, "Industrial Lichen" was hosted on Mozilla Hubs, allowing audiences to experience this scenario first-hand in a virtual environment and providing an immersive experience(see Figure 1). As Mozilla Hubs is about to close in May 2024, the work is now being transferred to a similar platform, STYLY, to offer a WebVR experience. This immersive experience enhances the interactivity and impact of the work, allowing audiences to deeply feel the concepts of time and environmental evolution conveyed by the work. Audiences are invited to think about human being's role in nature and the world, how our actions have affected the past, present, and future, and how we can co-exist harmoniously with nature in the rapidly developing age of technology.

Limitations and Future Works

From a technical perspective, the current iteration of "Industrial Lichen" does not incorporate precise engineering calculations or mechanical structural design. The modelling of lichen components utilizes abstract artistic approaches that could be enhanced through collaborations with biologists to achieve greater scientific accuracy in representing lichen morphology and growth patterns. On the creative front, while the abandoned factory environment aptly conveys the themes, situating the work in more diverse settings could further expand its contextual resonance. Augmented reality technologies, like Microsoft HoloLens 2, could enrich immersion by blending virtual and physical spaces. Regarding audience participation, subsequent user tests and interviews would provide valuable feedback to iteratively refine the VR experience for accessibility, usability, and responsiveness to different learning needs. Integrating gamification elements could also mo-

tivate interaction.

To strengthen the educational impact, companion curricular materials must be developed to activate critical reflection before, during, and after experiencing the artwork. Partnerships with sustainability education experts would enable the incorporation of research-based best practices. Long-term touring exhibitions with accompanying educational programming could broaden exposure, while transmedia adaptations would allow the project to manifest across platforms tailored to different formats. Therefore, this project has immense potential for technical enhancement, artistic experimentation, and leveraging immersive art as a springboard for vital multidisciplinary inquiries on the pressing sustainability challenges facing our world.

Conclusion

In “Industrial Lichen,” the integration of immersive experiences brought by WebVR with the artwork epitomizes the convergence of technological innovation and artistic exploration, creating a platform for audiences to delve into. “Industrial Lichen” employs a distinctive blend of irregular botanical elements and geometric mechanical structures, critically examining sustainability and environmental protection themes. This piece invites viewers to reflect on humanity’s role within nature, how our actions have shaped the past, present, and future, and how we might coexist harmoniously with nature in an era of rapid technological advancement. It prompts a deeper investigation into the relationship between human development and the natural world, underscoring the importance of sustainability. Although there are certain limitations regarding technological enhancements and audience engagement, this project demonstrates the potent capability of immersive experiential art to ignite critical discourse and foster creative inquiry.

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Authors Biographies

Xingzhi SHI is a visual artist who bridges art and technology. She earned her Bachelor of Engineering in the Department of Mechanical Engineering at Dalian University of Technology and her Master of Fine Arts in Communication Design from Pratt Institute in New York. She specializes in interdisciplinary design, including interactive, three-dimensional, augmented, and virtual reality.

Mengyao GUO is an award-winning Artist, Illustrator, and Graphic Designer based in Shenzhen and Macau. She is an assistant professor at Shenzhen International School of Design and Harbin Institute of Technology and a Ph.D. candidate in visual communication at the University of Macau. Her works have been widely included in several worldwide exhibitions, including CITYA, Art Vancouver, Art Fair Tokyo, Art on Paper, etc.. Her research has been published in the ACM Artech, ACM Chinese CHI, ACM TEI, ISEA and EVA London, etc., in Digital Media Art, HCI, and Art & Technologies.

Ze GAO is an artist and researcher based in New York and Hong Kong. He studied Multidisciplinary Fine Arts at the Maryland Institute College of Art and held an MFA in the School of Visual Arts in New York. With a background in art and technology, his research spans different practices and interests, including AI-generated content, virtual reality museum, interaction design, and human-computer interaction.