Paper Bark: Materializing Place

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Abstract

"Paper Bark" is a virtual reality experience about deterioration, decolonization, and regeneration. It uses generative algorithms, photogrammetric reconstruction, and image style transfer to reconstruct the past, show the present and suggest possible futures. Historically pulp and paper mills were the driving force of economic prosperity for many towns in the state of Maine with the industry peaking in 1967 [1]. Due to outside firms maximizing short term profits, the industry collapsed in the 1990s leaving mill towns impoverished. "Paper Bark" focuses on the remains of a 130-year-old mill in Winslow, Maine that closed in 1997 [2], and its past, present and potential futures. The mill is situated in the homeland of the Kennebis people who were displaced during the Indian Wars and sought refuge in other Wabanaki nations [3]. The name of the artwork is derived from the production of paper at the mill and the bark of paper birches, a native plant material used for making canoes, baskets and other goods. "Paper Bark" embodies the ecologies of place and shifting temporalities through a virtual reality, non-linear narrative about colonization, collapse and the potential future regeneration of a paper mill town.

Keywords

Photogrammetry, Style Transfer, Non-linear Narrative, Resilience, Cultural memory, Digital Ecologies, Place-making, Ecological Consciousness, Virtual environments, Place-based storytelling

Paper Bark

"Paper Bark" is a non-linear narrative of place. A photogrammetric reconstruction of exterior mill spaces is used as the backbone of the virtual reality environment, creating a 3-dimensional pixelated structure. Generative algorithms are used to represent time and regrowth, flowing water eroding the space, and plants growing out of what is left. Using image style transfer from photographs, the pixelated structure becomes solid, creating a non-linear spatio-temporal narrative of place.

"Paper Bark" shapes our understanding of place through the digitization of the mill's physical architecture, reframed through the lens of ecological elements like the accelerated rust from harsh winters, the flooding of the Kennebec River, and the regrowth of native plants. "Paper Bark" emphasizes the entangled, unrelenting revolutions of the seasons and spatio-temporal cycle of entropy and regrowth. After a desolate winter, rocks are colonized by lichen, allowing moss to establish itself, a process eventually followed by mushrooms, ferns and trees. Through a digital environment, "Paper Bark" investigates and illuminates these layered ecologies, the interconnected nature of place, time, humans, and the environment, building sustainable narratives and creating a fertile ground to speculate on what these spaces could look like. "Paper Bark" uses art and technology to explore the ethical considerations surrounding place-making practices through the lens of ecological consciousness.

Figure 1: Hollingsworth & Whitney Paper Mills, Winslow, ME; from a c. 1920 postcard. Image courtesy of Special Collections, Raymond H. Fogler Library, DigitalCommons@UMaine, https://digitalcommons.library.umaine.edu/spec_photos/929

Materializing Place

Photogrammetry The first step in creating the artwork was to use photogrammetry to reconstruct the space. To reconstruct one room of the mill, 436 photographs of the space were taken from 8 positions at various angles. Agisoft's Metashape was used to reconstruct the space as a point cloud which was exported as obj and ply files.

Point cloud manipulation The point cloud was then imported into Python and Unity3D. The point cloud was manip-

Figure 2: Pointcloud generated from 3D reconstruction of the space.

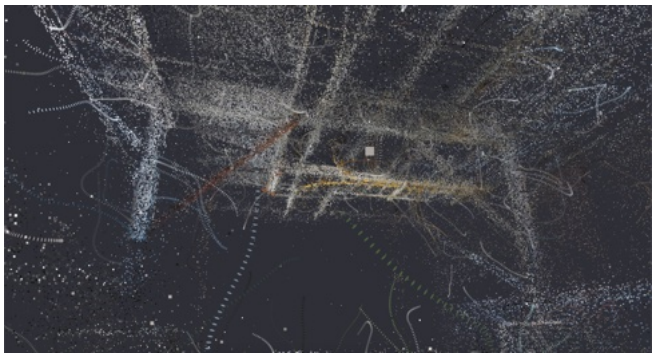

Figure 3: Pointcloud manipulation through vine growth.

ulated to express the effect of nature on the space including becoming overgrown by plants, covered by lichen and rust, eroded by rain and flood, and modified through the freezing/thawing cycle. Growth is represented through the use of l-systems [4] and cellular automata [5] and Perlin noise [6]. A particle simulation with gravity and force was used to represent erosion. As the point cloud was modified it was also saved at each step of decay and regrowth, creating an animated model of the changing mesh.

Style Transfer Style transfer was then used to modify each frame of the video. First, I collected photographs of nature, environmentally worn man-made objects, and historic photos and drawings of the mill. I included Maine native plants, moss, lichen, and mushrooms, as well as man-made objects that are covered in lichen, rusted or environmentally worn. The video frame and photograph were split into a grid of 512 by 512 pixel squares. The photograph was then applied to the video frame using image style transfer. Specifically, I employed the image style transfer method using convolutional neural networks described by Gatys et al. [7]. The video was then reconstructed from the resulting images.

Discussion

"Paper Bark" is an example of how art and technology can raise ecological awareness by starting a conversation about sustainable economies and technological infrastructures. It

Figure 4: Example images of style transfer process showing the photograph used for style transfer, the point cloud, and resulting image.

recontextualizes the practice of production using indigenous materials and place-based practices, emphasizing the importance of sustainable communities. Through the style transfer of historical photographs and natural materials, "Paper Bark" engages with collective memory and decolonization. The style transfer of historical and contemporary photographs of the mill, intermixed with photographs of lichen, moss and mushrooms tells the story of colonization and decay. The style transfer of photographs of traditional materials for making, like sweet grass, brown ash, and paper birch bark tell the story of the land before settlers and possible futures. Using creative applications of computation, non-linear storytelling, virtual reality and algorithms, "Paper Bark" reconceptualizes and reclaims the narrative surrounding place.

Author Biography

Hannen Wolfe is a media artist and Assistant Professor of Computer Science at Colby College. Their research is at the intersection of art and computation, building interactive art installations and staging robot performances that uplift underrepresented voices, question how we use technology, and dismantle systemic and structural inequalities. Their work has been shown at SIGGRAPH Art Gallery winning "Best in Show", the International Symposium on Electronic Art, NIME, CHI Interactivity, IEEE VIS Art Program, Contemporary Istanbul and others. Their research has been published in Leonardo and IEEE Transactions on Affective Computing. They earned a PhD in Media Arts and Technology and a M.S. in Computer Science from the University of California, Santa Barbara.

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