In a Mutual Light

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Abstract

Since 2015 artist Daniel Miller has pursued creative research that merges sustainable sculptural practices with robotic technologies. Miller's research has been primarily centered around the recycling and reuse of HDPE plastics in activated sculptural forms. His artist talk will highlight this progress starting with earlier works including *Ouroboros* and *Failure to Launch* and then focusing on his latest project titled *Mutual Light*, that will be included in the ISEA 2024 exhibition. Future projects will also be discussed.

Keywords

Robotic, Interactive, Plastic, Recycling, Light, Sculpture, Electronic, Sensors, Installation, Biometrics.

Introduction

For the past the 8 years artist Daniel Miller has endeavored to merge sustainable sculptural practices with robotic technologies. Miller's will discuss his recycling and reuse of HDPE plastics in Robotic Art forms. Exploring the properties of this material when activated with light and mechanical components. His paper will highlight this progress starting with earlier works and then focusing on his latest project titled *Mutual Light* (fig. 1).

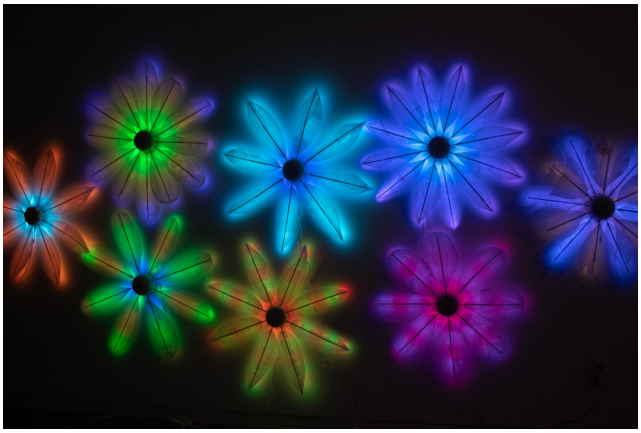

Figure 1. Mutual Light Installation, detail view, 2023. © Daniel Miller.

Earlier Works

Two earlier projects that influenced the trajectory of this research include, Ouroboros and Failure to Launch. Ouroboros is ancient symbol of a serpent or dragon eating its own tail. *Ouroboros* the robotic sculpture, completed in 2015, is an embodiment of this idea. Using various DIY mechanisms and components this robot extrudes a plastic coil like "tail" that winds across the gallery floor. The "tail" ultimately is returned to the robot's "mouth" as the machine's vacuum intakes the plastic "tail" grinds it back up, melts it down and re-extrudes the tail (fig.2). Instead of using a ready-made filament or plastic pellets the *Ouroboros* robot only recycles/consumes HDPE shredded plastic milk jugs. High Density Polyethylene (HDPE) is a ubiquitous material that can be found in a multitude of products. Over the past century plastic waste has become an enormous issue and recycling alone does not solve the problem. Miller's research connects to DIY communities and industry that continue to look for novel uses for this abundant human made waste material.

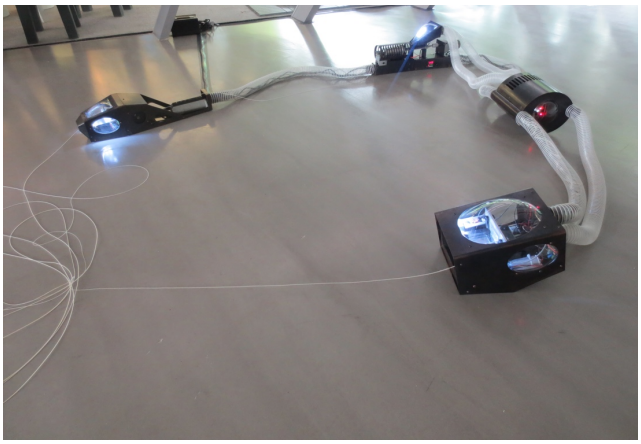

Figure 2. Ouroboros Installation, 2015 © Daniel Miller.

The *Ourobors's* "Tail" material is melted at a safe temperature of 350 degrees Fahrenheit (or less), where no off gassing will occur. All heat and shredding components are safely secured inside the "body" of the Ouroboros mechanism. Transparent panels provide windows into the body of the robot where observers can witness these processes unfolding. Parts of the robot are also made from cast HDPE

using a different process than the extruded tail. These recycled mechanical parts were cast and fabricated in Miller's studio at the University of Iowa. The processes used in *Ouroboros* connect to a larger DIY community where recycling of plastics into 3D printing filaments and other components provides a possible real low-cost alternative for individual and local production worldwide.

The success Miller achieved in working with recycled plastics in Ouroboros, inspired a new robotic body titled *Failure to Launch*. Here a large, folded wing made from cast recycled milk jugs is mounted to the wall of an installation space. As viewers walk into the space the wing unfolds and rises into the air. A rush of air is pushed toward the visitor as the wing lowers back toward the ground as if to take flight. Visitors can interact with a sensor or and RC controller to move the mechanism; in this way the wing becomes an extension of the viewer. This wing serves as a metaphor for the human condition, connecting to the story Icarus and his wings made from wax, however in this case the wing is made from thermo-plastic HDPE. Miller's young boys, ages 4 and 5 (at the time), consumed a great deal of milk, the HDPE was recycled from 7 months' worth of empty milk jugs. The plastic has been melted at lower temperature and then compressed into molds to make the boney appendages of this wing. The feathers are made from laminating the HDPE onto stainless steel rods. All this repurposing of the plastic is done with a simple domestic electric oven. The structure is put in motion with pneumatic actuators and controlled with Arduino micro-controllers (fig. 3).

Figure 3. Failure to Launch, detail view of retracted wing, 2017. © Daniel Miller.

Mutual Light

Miller's latest project, *Mutual Light* is an interactive light art installation where large illuminated artificial flower forms interact with participants, exploring social interaction and body heat of the visitors in the exhibition space. The changes in visitors body heat and proximity to the light sculptures will cause the flowers to illuminate in different color patterns, emulating organic flowers as seen in the Ultraviolet spectrum. These sculptural forms are sustainably made from repurposed plastic milk jugs, that the artist melted down and both slumped and cast into forms. In this project there is an inverse relationship, where the flower is now a light emitter rather than a light consumer and the invisible IR light humans emit is made visible.

In the installation space participants interact with the wall hung light sculpture through sensors embedded in the forms. Long range infrared thermometers in the center of each illuminated flower structure taking readings of the invisible heat signature of visitors. When body heat above a threshold is detected, the flowers will emit a red light from their center. As this temperature continues to rise the red color will overtake the flower. At the same time the robo-flora will precisely read the visitors distance to each flower using time-of-flight distance sensors. The flowers will read participants at a range of up to 120 inches. The distance sensor data will show change in the flowers color pallet when low body heat is detected by the IR thermometer. Additionally, four of the light flowers have an air quality sensor. When a data threshold is triggered these air sensors will cause the light in the flowers to bleach to white. The different sensors data is read by an Arduino Promicro that outputs to strands of individually addressable LEDs. The use of multiple flower structures allows the project to interact with participants in a larger public space, creating an immersive light experience (fig.4).

Figure 4. Mutual Light Installation, 2023. © Daniel Miller.

Each of the light flower's structures are made from HDPE recycled plastic that the artist has reclaimed from used plastic milk jugs. In this project Miller continues to find novel uses for this material as an art form. In the exhibition's installation, there are 10 electronic flowers, with each form measuring approx. 36 in. across. The flower petals are formed by slumping the HDPE plastic onto stainless steel rods in ovens. The flowers center structure has been cast and then machined into shape. Each flower petal has multiple strands of RGB individually addressable - LED light strips located on its back side. The center of each flower houses custom electronic circuits that connect IR sensors

and distance sensors to an Arduino and LED driver. The central portions outer surface is machined in various ways to mimic disk floret structures in flowers species. The LED strips will illuminate the HDPE plastic causing the form to glow. Cables that connect the flower structures reference the vine structures of a flowering plant. These luminous forms are constructed to hang individually so the artist will be able to customize the project to suite the installation location.

Figure 5. Mutual Light Installation, interaction detail, 2023. © Daniel Miller.

The project *Mutual Light* fits into number of sub-themes under the main ISEA 2024 theme of *Everywhen*. This artwork aligns with the sub-theme *Ecologies of Place* at ISEA 2024 as it looks to uncover hidden color spectrums and make visible the invisible. The light patterns that the flower forms emit mimics the color patterns of flowers as seen in the ultraviolet and infrared spectrum by birds and other animals. In this work our own body heat is a metaphor for the larger human impact on the global climate. Much of the time humans ignore the symbiotic relationship that exists between the plant world and our human species. Human life is extremely dependent on our green companions for air, water, food and shelter. *Mutual Light*, looks to remind visitors of this reciprocal exchange through an interactive light installation.

Mutual Light also aligns with the ISEA *Speculative Practices* sub-theme, as this experimental work explores new modalities between technology and Material. This is illustrated by the novel method of casting and slumping the recycled plastic that the artist has developed. This material provides a lightweight medium for use with robotic motion components. The HDPE recycled plastic is an ideal material for interaction with LED illumination. The LED strips in this work reflect their light off the gallery wall to create a smoother indirect illumination. As the light passes through the HDPE petals it is further diffused and transmitted through the plastic (fig. 6).

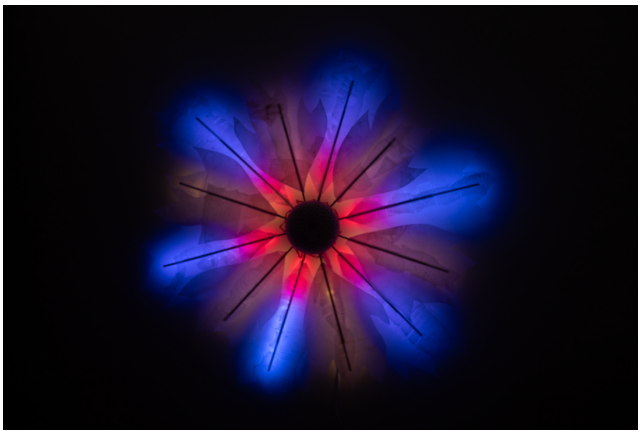

Figure 6. Mutual Light Installation, detail of flower, 2023. © Daniel Miller.

Conclusion

In conclusion, there is an abundance of readymade and scrap materials available for artists to integrate with their current creative practices. Daniel Miller has chosen to focus on one material, and do an in-depth examination exploring the potential for repurposing HDPE in robotic art. The use of HDPE has clearly enhanced the potentials of the art projects presented here. Miller has created an original design that integrates sustainably fabricated forms made from discarded plastic with various custom electronics and software to create an engaging experience. Future projects are planned that will continue to expand on the potentials of this material when activated. Daniel Miller looks forward to continuing his exploration of alternative recycled materials that have a minimal environmental impact for robotic art.

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Author(s) Biography

Daniel Miller uses robotics, electronics, sound, video and light to investigate systems and ecologies in the contemporary landscape. Currently he is an Associate Professor and Area Head of Sculpture & Intermedia in the School of Art and Art History, University of Iowa. In addition to many exhibitions in the USA, Miller's artwork has been shown in Italy, Switzerland, Ireland, Korea, and Columbia. He has received numerous commissions, grants and awards to support his research.