Collective Currents
Exploring Sustainability through a Collaborative and Interactive Installation
ERIK BRUNVAND AND WENDY WISCHER

Water issues in the western United States include a long history of struggle, controversy and politics. Collaboration and compromise are required to achieve desirable outcomes in water quality and water rights. Collective Currents is an interactive art installation, developed collaboratively by a computer engineer and a multimedia artist, that explores the idea of cooperative experience in both literal and conceptual ways and creates an environment that makes reference to and engages the viewer to think about our ability to understand and solve environmental issues, specifically water quality and conservation, through collaboration.

Water is the true wealth in a dry land.
—WALLACE STEGNER [1]

In June 2010 a small (10-inch diameter) oil pipeline belonging to the Chevron Corporation sprung a leak [2]. This pipeline transports medium crude oil from western Colorado to a Chevron refinery near Salt Lake City, Utah. The crack causing the leak was only half an inch long but occurred at the point at which the pipeline parallels Red Butte Creek near the University of Utah and Red Butte Garden, a botanical garden associated with the university. Before the leak could be contained, over 800 barrels (33,600 gallons) of oil had spilled into the creek and onto its banks. Three miles of the creek were affected and required cleanup.

The Red Butte Creek oil spill brings into focus ongoing issues with water quality, environmental preservation, industrial responsibility and water conservation that are of particular concern in the arid western United States of America. The history of water use, exploitation and conservation has been a defining issue since the early days of European settlement in this part of the world [3].

The conceptual underpinning of our artwork Collective Currents is our desire to explore issues of water quality and conservation through an interactive and collaborative art installation. This installation (seen in Fig. 1), while referencing the specifics of place in captured audio and video, also invokes a crisis arising from humanity’s thirst for oil and explores how the pursuit of oil is compromising our essential global water resources. Collective Currents is layered in concept, with collaboration at its core.

Through this installation, we—an artist and an engineer—have sought to create a work that bridges gaps between disciplines in search of greater understanding and impact than either of the disciplines could achieve alone. With this piece, viewers can become involved with environmental concerns through direct interaction with the installation. Collective Currents requires viewer participation to reveal its full meaning: Alone we can make a small difference, but when we come together, we can make a much greater difference.

While we have built the conceptual foundation of Collective Currents on environmental issues and the idea of collaboration, we nevertheless intend for it to be, at its core, an art installation with no explicit didactic content. We believe that art can and should sometimes ask questions without...
providing answers, moving the viewer in emotional and subjective—rather than objective—ways. When we are "moved," we tend to act. Critic Arthur Danto addresses the role of the viewer's interpretation in his book What Art Is: "The artwork is a material object, some of whose properties belong to the meaning, and some of which do not. What the viewer must do is interpret the meaning-bearing properties in such a way as to grasp the intended meaning they embody" [4]. A work of art can provoke the viewer to come to conclusions based on their own understanding, which more deeply connects them with the content. The work can also provoke conversations with others that lead to new conclusions and interpretations, with the possibility of leading them back to the original data, or to completely new interpretations.

Often the artist, like the scientist, seeks to identify connections or patterns that are not necessarily apparent to the typical observer. This search for a common—but not readily accessible—thread can broaden research, sometimes leading to exploration of areas not directly related to the observable evidence. Artists may explore areas that are separate from the original question and go in a different direction than the conclusion, yet prove to have links—from emotional, psychological, cultural and discursive connections—that then offer new ways of seeing and understanding the original data or questions.

In Collective Currents, while we do not make the environmental and cooperative underpinnings explicit (as one might in, for example, a science center exhibit), we hope to evoke in viewer-participants a feeling that, as we create and utilize new digital technologies for advancement, it is our ability to embrace our human connections that will propel us forward to make the impossible possible and create what we cannot yet imagine.

ARTS/TECHNOLOGY COLLABORATION

Cambridge University physical chemist and influential writer C.P. Snow devoted his 1959 Rede lecture at Cambridge to the growing, and regrettable, divide between engineering and the sciences on one side and humanities and the arts on the other. In this lecture, subsequently published as The Two Cultures and the Scientific Revolution, Snow says:

I believe the intellectual life of the whole of western society is increasingly being split into two polar groups. . . . This polarization is a sheer loss to us all. To us as a people, and to our society. It is at the same time practical and intellectual and creative loss, and I repeat that it is false to imagine that those three considerations are clearly separable [5].

We find it striking how relevant Snow's ideas are even today and how the divide between the "two cultures" has seemed only to widen since his essay was published. One specific catalyst for our development of Collective Currents was our mutual interest in bridging those cultures through arts/tech collaboration. Author Brunvand's research and teaching interests include the design of application-specific computers, graphics processors, asynchronous systems and VLSI integrated circuit design. He is also interested in arts/technology collaborations in research, practice and education. Author Wischer's interests include the space in between disciplines in which sculpture intersects with film, dance, theater, architecture and engineering, with a specific focus on environmental issues both symbolically and as a restorative art practice.

As artists and researchers, we had been talking for some time about working together on an interactive installation. The 50th anniversary in October 2016 of the 9 Evenings: Theater and Engineering performances in New York was the starting point for our conversations [6,7]. The 9 Evenings series was the brainchild of artist Robert Rauschenberg and engineer Billy Klüver and was originally presented in October 1966 in the Armory building in Manhattan. The project brought together artists from New York and engineers from Bell Laboratories to collaborate on performances that were part theater, part performance art and part interactive experience.

While the actual installations and performances in 1966 were not universally embraced at the time and suffered from a number of technical glitches, the lasting impact of 9 Evenings has been—like Snow's Two Cultures—to raise the idea of cross-disciplinary collaboration and the bridging of the cultural divide between technology and the arts. One direct result of the performances was the formation of Experiments in Art & Technology (E.A.T.), an organization dedicated to connecting artists and engineers in cross-disciplinary collaboration [8].

Through 9 Evenings, Klüver and Rauschenberg sought to utilize the emerging palette of technology in new and exciting ways. In particular, Rauschenberg wished to create spaces in which the art and the viewers could interact in ways that had not been possible up to that point. Later, Klüver wrote, I came to believe that a hands on, working relationship between the artist and the engineer was the means for providing the artist with access to technology. Rauschenberg's strong commitment to the idea of collaboration shaped my thinking. We evolved the idea of the equal collaboration between individuals in these two fields contributing to a joint project [9].

While Klüver was writing about activities in 1966, those words describe the type of collaboration that we find fascinating—and fascinatingly rare—even today [10,11].

We believe there is power in true collaboration that starts with the conceptual ideas and continues through the embodiment of those ideas. Thus, this collaboration is an extension of Klüver's idea that "engineers are not artists, and artists can't do their own engineering. Artists and engineers are separate individuals, and if they work together, something will come out of it that neither can expect" [12]. If we allow each party to bring ideas and knowledge to the project, this enables the possibility that the resulting work is stronger in both concept and embodiment than it could be if developed from a single point of view.

It is unlikely that any one collaborative project will add to fundamental new knowledge in the field of either collaborator. Instead, the power of a true collaboration is that it can
expand and enhance each collaborator’s views and perspectives. We embraced this notion and extended it: We believe that the conceptual complexity of a collaborative project that itself has collaboration as a fundamental interaction principle allows the piece to become more expansive.

At the same time that we as collaborators were considering the legacy of 9 Evenings, we were also engaged in an ongoing conversation about water in the western United States. The result is an interactive installation sculpture that is layered in meaning with collaboration at its core, both conceptually and literally, and with water conservation issues as a conceptual underpinning. Without providing direct didactic guidelines to viewer-participants, we intend to provoke in them thoughts about collaborative engagement in issues relating to conservation by encouraging them to literally collaborate with one another as they interact with the installation.

**INSTALLATION AND EXPERIENCE**

When a viewer enters the gallery space, they see a curved wall 4 feet tall by 20 feet long suspended from the ceiling, which functions as a custom projection screen. Projected onto the curved white surface are disparate video fragments of flowing water that are strangely distorted and discolored. Audio is playing that is reminiscent of the sound of flowing water, but the audio, like the video, is distorted and not clearly identifiable. The viewer also sees a pair of pedestals, each with a cast bronze hand that invites the viewer to grasp it and thus make physical contact with the installation.

The pedestals are placed far enough apart that a single person cannot reach both of the bronze hands, and touching a single bronze hand does not have any effect on the installation. However, when two visitors hold hands to create a chain between the bronze hands, the video fragments begin to move toward one another and both the video and audio start to become less garbled (Fig. 2). When a third viewer joins the chain, the video fragments move even closer toward one another and the images and audio begin to get even clearer. This continues as more people enter the space and connect hands in the chain: The video images and sounds resolve to be more cohesive and comprehensible and the water in the stream clears of distortion to become a clean flow.

This human connection with the installation is significant on many levels. The larger the human chain, the more cohesive the sounds and images are in relation to one another. This implies that it is only through the cooperation of a critical mass of participants that the message, images and sounds can be completely integrated. While the picture becomes clearly identifiable as clear, clean, babbling water, there is still overlap of some of the image fragments and imperfect unity. This inability to attain complete resolution reflects the challenges and tensions of disparate views throughout a community and the difficulty of gaining consensus.

At the same time, a natural discomfort with holding hands—especially with strangers—contributes to a potentially wide variety of interpretations and reactions by viewers. Compounded by a culturally ingrained reluctance to touch works of art in a museum, this natural discomfort can invoke layered reactions including rebellion, cooperation, unease and enlightenment, alongside the satisfaction of solving the “puzzle” of the interaction mode of the installation.

**INSTALLATION DETAILS**

The foundation of *Collective Currents* is a set of video and audio recordings made on site at Red Butte Creek. We made recordings of clean, clear, flowing water and then manipulated them to create distorted, garbled versions as contrasts to the originals. The relative clarity of the video and the audio, depending on viewer participation, is the result of blending between the fully clear and fully garbled versions. The blending is accomplished through a Processing [13] program running on a laptop concealed in the third, main pedestal of the installation. Also sitting on the main pedestal is a set of 15 acrylic mirrors mounted on pan-tilt assembly driven by servos, as seen in Fig. 3. Each pan-tilt uses two servos for two degrees of freedom. The 30 servos are driven from external servo driver boards controlled by an Arduino [14] controller. The use of physical mirrors that move to assemble/disassemble the video images contributes to the interactive and performative aspects of the installation.

The Arduino also reads information from the human-chain sensor circuit to determine how many viewers are collaborating. There are many possible circuits to allow a human...

---

**Fig. 2.** Collective Currents, installation view, with museum visitors. (Photo © Erik Brunvand) When visitors collaborate to form a human chain between the bronze hands, the video and audio begin to coalesce and lose their distortion.

**Fig. 3.** Erik Brunvand and Wendy Wischer, Collective Currents, main pedestal, mirrors on servo-driven pan-tilt heads. (Photo © Erik Brunvand)
touch to make a switching contact. For this installation we wanted to know not only that contact was being made but also how many people were cooperating in a human chain between the sensors.

For this we implemented a voltage divider circuit that creates a different voltage depending on the total resistance in the human chain between the contact points (see Fig. 4 for details). The human body has, depending on skin dryness, between 1,000Ω and 100,000Ω resistance from hand to hand [15]. This means that a voltage divider with a fixed resistance of around 100,000Ω allows a reasonable voltage range to be detected, considering that multiple bodies may be connected serially between the electrodes. This voltage can be easily sensed with the built-in analog-to-digital converter in the Arduino and is a suitable indication of how many people are in the chain—it rises as more people are added to the chain and thus increases the net resistance between the electrodes.

The number of people in the chain sensed through the voltage divider circuit drives the manipulation of the mirrors. As the Arduino-controlled mirrors are moved, the fragmented video pieces projected through the mirror reflections come closer together and merge on the screen. The more humans in the chain, the more resolved the image on the screen becomes. The number of people in the human chain is also passed through a serial connection to the Processing application running on the laptop and is used as a guide for how to blend the garbled and clear versions of the video and audio content at any given moment. The applications running on the Arduino and those running on the laptop through Processing work together to smooth out the changing values to make the apparent motion of the video and changes in the clarity smooth, even though the numbers may change quickly as people join and leave the chain.

We chose to cast bronze versions of our own hands as the connection points to give visitors a feeling of comfort and human connection within the installation (Fig. 5). We had hoped that the presentation of a human hand reaching out would be a clear invitation to touch the hand, without the need for detailed instructions, but we found that viewers still needed encouragement because they had been conditioned to not touch objects within a gallery setting.

CONCLUSIONS

Of course art cannot change the world alone, but it is a worthy ally to those challenging power with unconventional solutions.

—LUCY LIPPARD [16]

Collective Currents is an installation that arose from three strong interests of ours: collaborations between arts and technology, interactivity in installation art and the exploration of issues related to water conservation and protection. We believe that this installation is powerful both because of the visual and aural impact of the actual installation and because of the direct interaction of the viewer with the piece and with other viewers. Indeed, the meaning and impact of the piece becomes apparent only with that interaction.

We hope that through this type of interactive sculptural installation we can provoke discussion of critical issues of our time. When we as human beings come together, we can increase our knowledge, experience and efforts to solve our most challenging problems. The environmental crisis is seen by many as the greatest obstacle facing humankind right now. It will be our human connection with our surroundings and with one another that will allow us to tackle this crisis and find solutions.
References and Notes


Manuscript received 20 May 2019.

ERIK BRUVAND is a professor of computer science at the University of Utah, where his research and teaching interests include the design of application-specific computers, graphics processors, asynchronous systems and VLSI integrated circuit design. He is also interested in arts/technology collaborations in research, practice and education.

WENDY WISCHER is an associate professor in sculpture intermedia at the University of Utah, where her interests include the space in between disciplines where sculpture intersects with film, dance, theater, architecture and engineering, with a specific focus on environmental issues both symbolically and as a restorative art practice.