Code in the Clouds: Situated Technologies in Public Art

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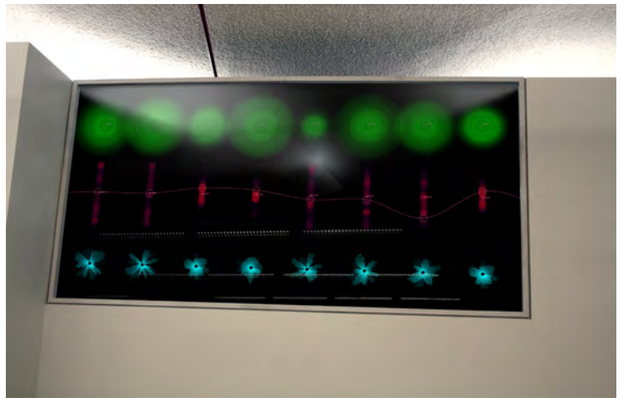
INTRODUCTION

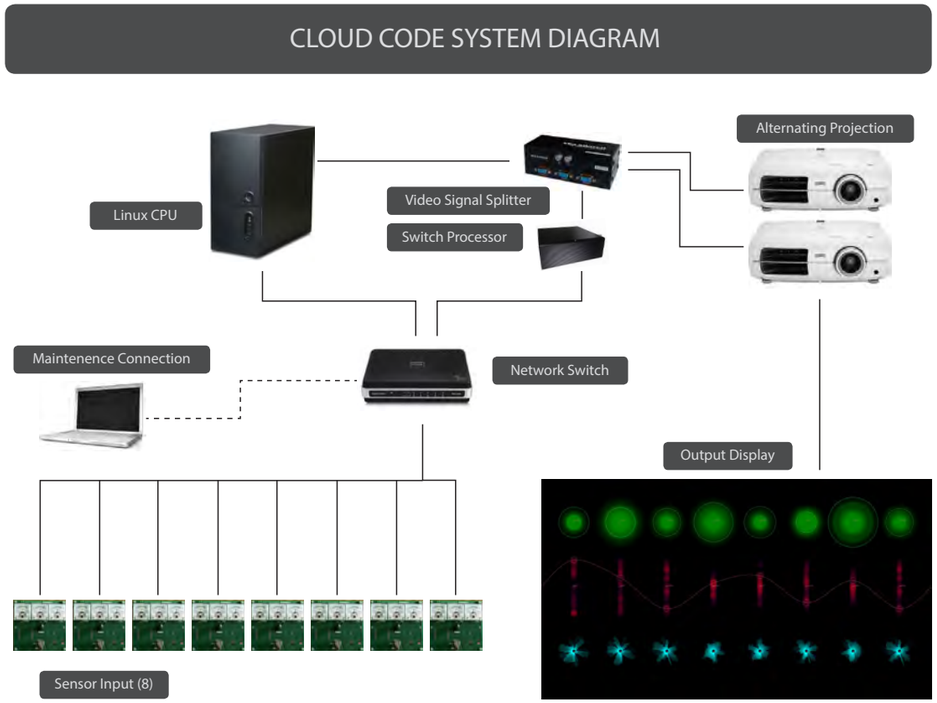
The use of sentient technologies in managing building information for the surveillance and control of occupants is by now a ubiquitous presence in public space. By connecting sensing nodes to nested networks, the urban landscape and infrastructure is monitored and altered with feedback loops generated by individual actions and reactions. The aggregation of human behavior creates clouds of effects that can be measured as systems employ the use of algorithms to learn patterns, anticipate social tendencies, and push them to a desired outcome.

It is within this field of live phenomena that we have situated some of our work in the realm of public art to create threads of inquiry and produce a series of interventions that deal with the display of activated data in a custom temporal matrix. This art exists in four dimensions and is informed by variable input that forms a registration through variable output. Parametric design is not only a process of form-finding and static articulation of fluid form, but also an ongoing electronic process that unfolds in the past, present, and future of the spaces we sense.



Cloud Code, rear-projected image of animation on glass

The world of physical computing is, on the one hand, expanding in its reach to measure and control a global system of exchange of information. At the same time, the nodes of connection are shrinking to become integrated in the surface of things or disappearing altogether. The purpose of this art is to ponder the state of

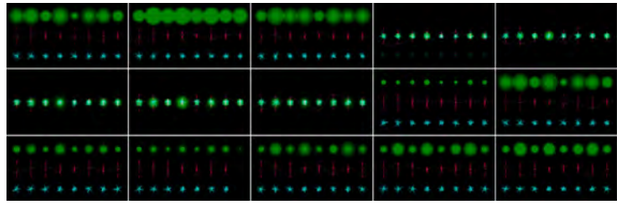


technology at a given moment and produce content that measures the pulse of a space and repeats it as a mirror back to the subjects viewing and inhabiting it. These projects don't exist in the rarefied air of the art gallery but rather in public spaces, where their interpretation is based on the interaction of technology with everyday activities.

CODE CLOUD

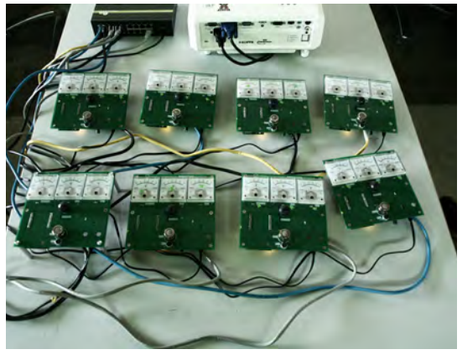
Cloud Code (2011) is a public art commission with which we sought to create a graphic display of real-time building information related to actions of the occupants and the air quality index of the space. By measuring motion, sound, and CO2 simultaneously, the domain of activity becomes a series of inputs into a system of sensors, processors, and visual projectors to produce an algorithmic painting of the space that is never the same twice.

Cloud Code, screen shots of animated image based on varying sensor inputs at each column location. Green bubbles = sound, red waves = motion, blue sonar = CO_2



We built a physical network from the electronic components up and coded custom software to process the data into an interlaced graphic display of building information. The qualitative effect of information parsed from the space was initially registered on analog meters at the sensor locations. We built custom enclosures with textual instructions and Shure microphone hardware that provokes interaction at the nodes in the network sited in the space. The sensors connected to custom circuit boards are hard-wired through the space to the computer that processes the signals into the layered interface that registers the activity at each sensor node. The algorithmic graphic is then projected on a large rear projection screen in the space. Each sensor node is located on one of eight existing columns of the space. The animation is organized as an abstracted floor plan of activity repositioned and scaled to a 5' x 10' rear projection screen.

The location for the work is in the City of Houston Code Enforcement Building, within the main lobby and waiting space. This facility has the capacity to measure the economic pulse of the city by regulating the commercial and residential building activity. We sought to channel the banalities of bureaucratic activities in a cybernetic event integrated with the space.



Left: Central Permitting Center waiting area, stainless steel sensor enclosure on existing concrete column

Right: Sensor boards connected to network for testing prior to installation

The animation patterns are differentiated with concentric circular swells, radial radar-type dials, and a waveform, each attached to individual motion, sound, and CO2 sensors. The effects in the display intensify and dissipate according to the levels of influence throughout the day. Cloud Code is an ephemeral work that is integrated seamlessly into the architecture of the space. It blurs the boundary between a moving spatial map as public art and situated technology that monitors activity for control of people and information.

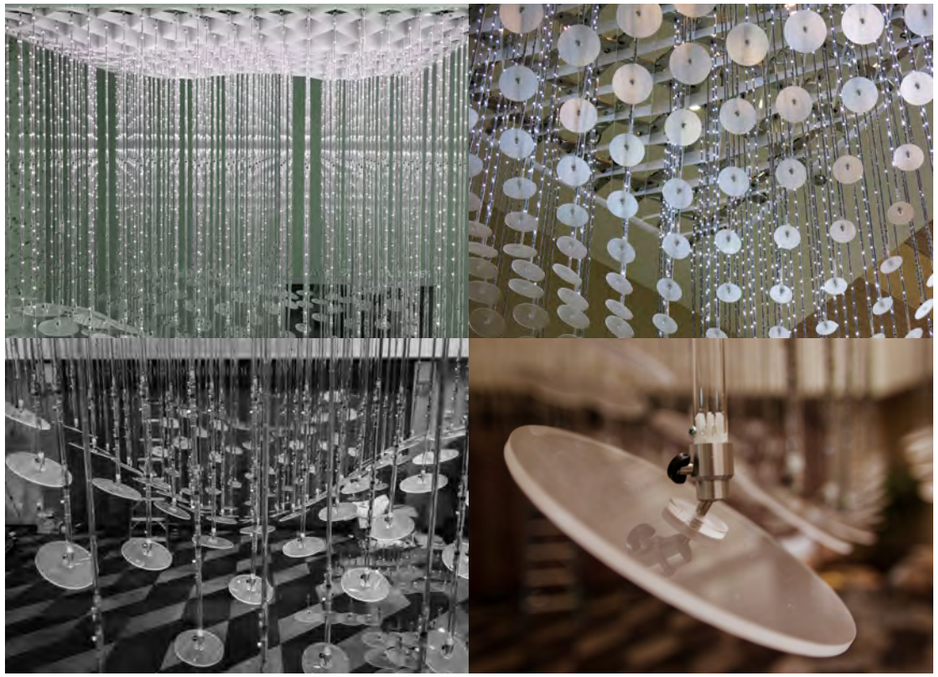
Cloud Code is ultimately a comment on the relentless presence of enumerating technology in our lives and how it constantly tracks and quantifies without being transparent about the agenda of the operator—if there even is one. In this case, it is a perfectly useless apparatus, but it is integrated in such a way that it becomes a provocative presence in a bureaucratic system that lacks purpose for other reasons. It is this continuity of sentient technology with built architecture that we find so intriguing and beautiful to witness as an aesthetic expression of time in space.

MEMORY CLOUD

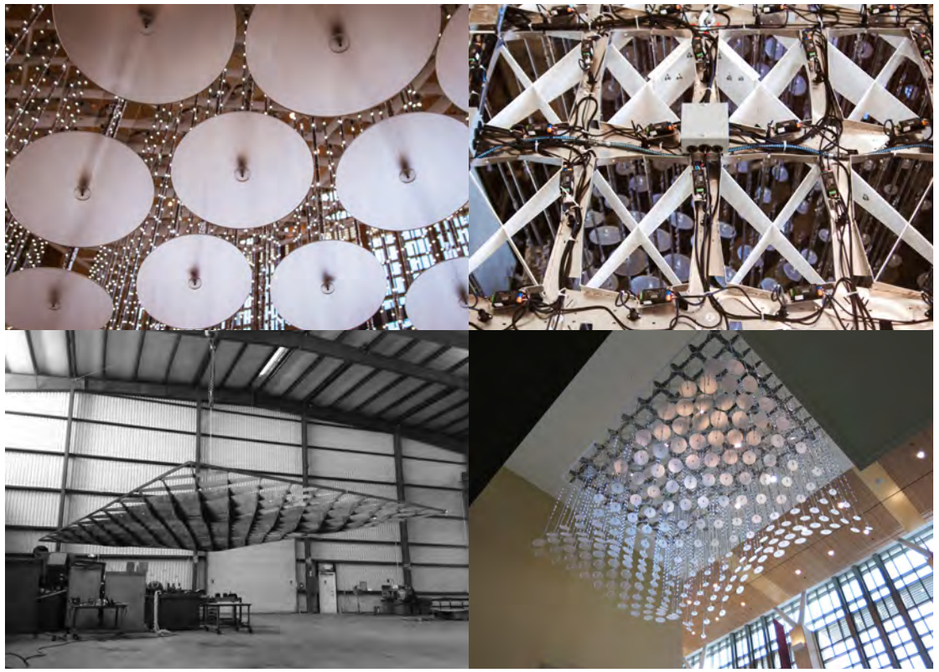
Memory Cloud (2013) is a subsequent commission awarded to a team made up of RE:site (artists Shane Allbritton and Norman Lee) and our studio, which provided design optimization through parametric modeling, digital fabrication consultation, and construction management services. The project is sited on the Texas A&M University campus, in the Memorial Student Center. The request for a proposal suggested that the work should manifest the activity on the entire campus at a primary point of convergence of public pedestrian flows. The concept was to frame past, present, and future events in a sculpture that was in a constant state of flux. Like clouds moving through the sky overhead, the work would provide an evolving figuration of moving human silhouettes. The notion of timelessness was critical in collapsing the immediate present with events in the past as if an event from many years ago is happening again in synchronous real-time.

The culture of this particular university is one of deeply ingrained traditions that are played out each year in the student's activities. These actions are iconic in nature and provide an interesting tableau of content that could be fed into a system that abstracts it into nebulous moving apparitions in a field of light. A matrix of LEDs was proposed that could be programmed with video loops of recorded events with an intervening feed from a camera discretely embedded in the main concourse of the atrium. The video signals from the various sources are processed into a 2D pixel space that is mapped into the topological space of the 3D array. Cartesian coordinates are translated into UV points that extrude and warp the profiles into the space by addressing each node with a uniquely coded output. The algorithm allows for perspective correction to enhance legibility from the primary point of view. From other angles, the literal figuration is replaced with a vague registration of activity in the space projected to a monumental scale with subtle gestures made of flowing intensities of light.

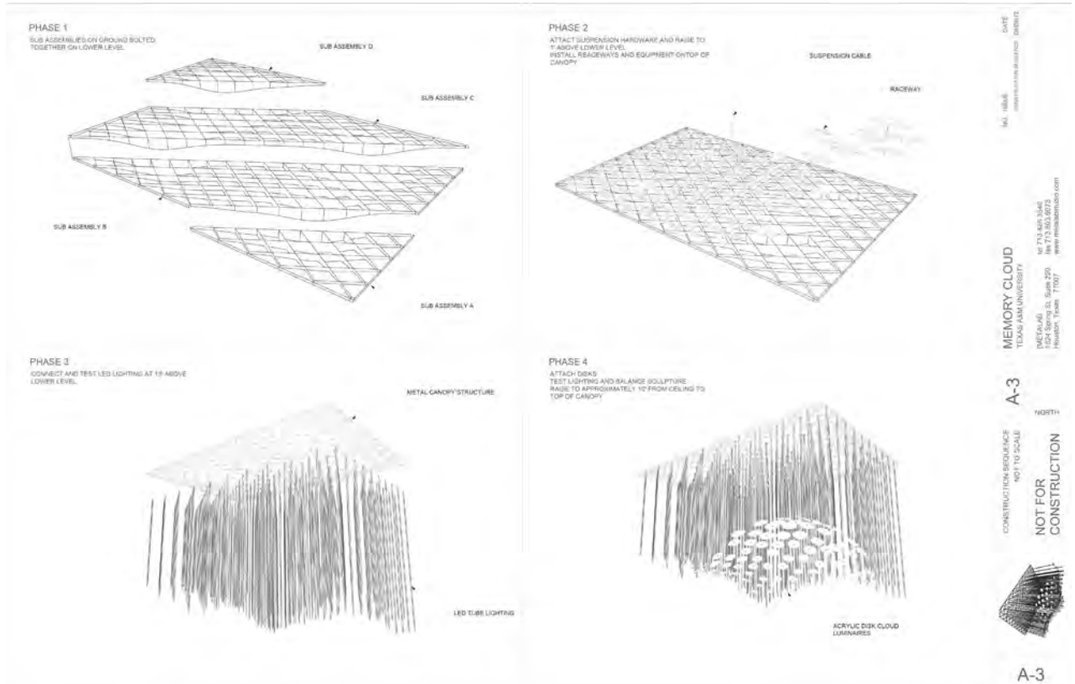
The project offered the opportunity to design and fabricate a physical computing network on a large scale with durability as a key concern for a permanent installation. The lighting system is controlled with DMX protocol, the standard for the theatrical effects industry. A media server is located in a remote space and transmits the data signals via a closed loop fiber-optic network to the top of the canopy. The sequence of 4000 nodes of light are split into 220 tube stacks and 11 DMX "universes," each with a different quantity of pixels connected in daisy chains. These data signals are conveyed on one network of cables while low and high voltage power are carried in a separate wiring system that provides electricity to each LED column in zones within the field. We developed a custom pan-formed raceway component with optional clips to manage the wires and provide platforms to attach pixel tube drivers, 5 V distribution panels, and power ballasts. This layer in the assembly allowed for selective wiring and pre-installation of parts as an aggregation of modules that expedited the on-site time as a plug-and-play operation.



Top left: Canopy and lights; Top right: Luminaires; Bottom left: Array of luminaire disks installed at the end of LED columns to produce the bottom of the cloud; Bottom right: Luminaire disk position is calibrated with a universal joint hacked from inexpensive camera tripods.



Top left: Dilated disks; Top right: Raceways installed; Bottom left: Canopy initial assembly; Bottom right: Installed work in atrium, view from lower level



Below the horizontal raceway is a vertical diagrid waffle structure made of 11-gauge carbon steel that was water jet cut and welded into four sub-assemblies that shipped and bolted together to form the main structural canopy. The constraints of the design required that the entire work had to suspend from one cable rigging point in the ceiling and be lifted into place with a concealed winch. This mandate afforded an opportunity to rationalize the form with parametric design that created a variable depth in the section of the 14' x 21' canopy—from 10" to a thin 1.5" at the perimeter with no deflection. The one vertical support at the ceiling splits into a four-point lift that connects to special saddles on the ribs at roughly .25 points from the perimeter. The structural engineering consultant ran a finite element analysis to assist in determining the optimum depth, suspension location, and how shallow we could go at the double cantilever. This process removed material from the ribs to make them as light and elegant as possible. There was a 3000 lb. weight limit to the entire project, and through this design optimization process, we were able to stay well below that and still use a heavier but cheaper sheet material.

The design of the suspended lighting array played off the undulation of the canopy with a secondary 3D sine wave form that defined the underside of the assembly as a luminous suspended landscape. The design of the surface was informed by views and circulation patterns in the atrium approaching the piece from multiple heights and angles of encounter. Given the rough budgetary target provided by the lighting consultants, our parametric model was initially calibrated to allow no more than approximately 4000 lighting nodes in the system. As the design progressed after commissioning, an LED tube product was specified that was specially manufactured with the desired light color temperature and node spacing but came in set modular lengths of 1200, 600, 300 and 180 mm. Through a sorting algorithm, each LED column was divided into the correct sequence of tube units to add up to but not exceed a variable length between approximately 9' and 13'. The remainder of the aggregate length of each was translated into a field of disk-shaped luminaires that lock into the z-axis position. The disks vary according to their angle, rotation, and diameter. The diameters dilate to 18" as the tubes become shorter to help to return the center of gravity to the centroid of the canopy. They contract to 6" on the longest tubes to form a translucent surface that modulates the light when viewed from below, further disrupting the viewer's relationship to the legibility of the overt figuration of human forms in the lights. The normals of the lower cloud were referenced to find the form of the surface and set the angle of the disks, which was achieved in the field with a universal joint hacked from off-the-shelf camera tripods.

An infrared camera, part of the discrete surveillance system that captures movement in real-time, is installed in an adjacent concourse without visual connection to the work. This was to provide an intentional disconnection between the various paths of flow through the building and in the artwork itself. The viewer of the display, not knowing where the camera is, does not know if the silhouette transmitted in the lights is an image of themselves or another occupant, or themselves as they were in the recent past. It is this ambiguous relationship with the recording of movement on the campus and the resulting evanescent experience that this project sought to create. The architecture and our knowledge of materials, fabrication, and data networks were employed in service of the precise alignment of components to convey the effects of the concept on a monumental scale.

CONCLUSION

Cloud Code and Memory Cloud represent a thread of design strategies in our work that expands the notion of how art, driven by interaction, can be integrated into public spaces. They engage a fundamental inquiry into how an architectural project can channel and test some experimental trends of contemporary design technology. These projects represent an evolving set of tools as a work-in-progress that we seek to apply to more complex scenarios using distributed sensing to build responsive environments.