

**inside/out:
mirrors for reflective, creative thinking**

Edwina Portocarrero Navarro

Submitted to the Program in Media Arts and Sciences, School of Architecture and Planning, in partial fulfillment of the requirements for the degree of Master of Science in Media Arts and Sciences at the Massachusetts Institute of Technology

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ABSTRACT

In this document I present three tools for reflective, creative thinking: Pillow-Talk, the NeverEnding Drawing Machine and Calliope. These tools make use of the “distorted mirror” metaphor for self-reflection. They are designed to debunk myths of creativity as an acquired faculty and instead promote creative apperception and flexible thinking.

Pillow-Talk is designed to prime dream recall and facilitate capture through voice recording. Considering the dream an aesthetic experience we all undertake, where the dreamer is free to test knowledge liberated from physical and moral constraints, its aim is to promote flexibility in levels of thought.

The NeverEnding Drawing Machine and Calliope endorse flexibility in vehicles of thought through co-creative and collaborative play. One can incorporate any object found in the environment as a tool or material, thus making contextualized and personalized creations. They promote cross-cultural and cross-generational co-creation as the echo from which to recenter perception.

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Prologue

The last time I saw my grandmother, she had no idea who I was. I sat by the foot of her bed; she seemed happy to have company. Knowing that in all probability this was to be the last conversation we would have, I started asking her about her life, about how Nicaragua was back in her youth. I wanted to know her. I had just finished a book on the history of Nicaragua, and not knowing I was her granddaughter, she seemed surprised to have a stranger that was knowledgeable in matters that were close to her. We became friends.

Our different ideologies made for an interesting conversation. She lived in a Nicaragua led by Somoza first hand and I was Sandinista in my romanticized ideology. I asked her what her fears and desires were in the know that death was lurking and when all that she would leave behind was our memory of her and her belongings. In the comfort of a stranger we talked at length and advised each other. After seventeen years, it took the anonymity of one afternoon to meet my grandmother and for her to meet me.

A few years ago and almost by accident, I took upon babysitting three television-deprived kids, 6, 9 and 11.

Until then I had been uprooted; home was the objects I traveled with and the people that welcomed me. Little did I know that the trip did not end there; every day, every hour, I had a different name and inhabited a different world made of complex landscapes and governed by shifting moral systems; where household objects were liberated from their function to perform in a play that was not less real than the world outside the walls of that house. My mind had to be alert, flexible and hugely responsible. Role-playing exposed my emotional state and my moral stance, all reflecting back from the minds of those kids, creating a cycle where I cared for their nurturing as if it was my own. For it was, and it is.

I hope the research done during my Master's degree and its culmination in this thesis and shape and function of Pillow-Talk, the NeverEnding Drawing Machine and Calliope reflect my appreciation for the people that have nurtured my understanding and given me the time and space to do, be and care.

“Between a frightened master and a resentful slave no true
love is possible.”

-A.H. Maslow

Section 1

Introduction

There seems to be a general concern about the unpredictability of the future in a world that is changing faster than we can keep up with, and in order to adapt, it appears that everyone, from education to commercial businesses, is calling for more flexible, creative modes of thinking. Creativity is almost becoming a trend, being valued as highly as expertise as an asset to achieve “success.”

Thinking creatively though, requires fluidity between abstract and concrete, internalizing and externalizing, combining new information with pre-acquired knowledge. Thinking creatively demands self-knowledge. [Ackermann, 2007]

But it seems like the same environment that demands flexibility of mind overlooks the need of time and space for creative thinking; and the crucial role that reflection plays in the equation. Primary materials for creative thought are usually subdued to secondary ones, imposed from above and outside. Information technologies have focused on access and distribution of media, their highlight being the capacity of personalization and exchange, but little attention has been paid to the creation of content itself. We are transmitters of information working at an amazing speed, anxious to “fit in” to an external reality. Rarely do we find or give ourselves the time or space to internalize, incubate and externalize. We copy formulas for happiness, sedated from knowing ourselves and thus contributing to a homogenous society.

When the environment does not demand creative engagement and asks for compliance, a sense of futility pervades. Our creative nature is overtaken by the one of consumers and transmitters.

Creative apperception is of crucial importance to psychological health. “It is only in being creative that the individual discovers the self.” [Winnicott, 1971]

Robert McKim states that we can only become integrated beings if we are able to transfer back and forth between rational and emotional, to plunge into the unconscious and bringing it up to conscious attention, in short, when we are able to have an ambidextrous mind. [McKim, 1972]

It seems though that not only can many of us fail to recognize that we live our lives not creatively; we also have been sold a myth of creative handicap. Even personal experience seems to have become a manufactured consumable. Creativity is commonly relegated to a selected few as if it was something we could at best acquire instead of exercise.

But how is one to exercise and maintain a truly creative apperception? How can we acknowledge ourselves as creative beings, appreciate the uniqueness of our vantage point and debunk myths of creative handicap?

Access to our mental process, the ability to step in and out from ourselves through perspective taking, endorsing the value of personal experience and providing a time and a space to reflect need to be considerations taken when designing tools for creative thinking. Technology should help us engage in an inner dialogue through which personal, original content can emerge.

If the artifacts we create are the springboards of further creative thought, I hope that these emerge from the acknowledgement of an internal state and an external stance, and that the tools to create them tacitly celebrate the many paths to knowledge acquisition.

In this thesis I present three tools to foster creative thinking: Pillow-Talk, the NeverEnding Drawing Machine and its evolution into Calliope.

Pillow-Talk is a tool to aid dream recall. Its aim, beyond exposing the dreamer to the wealth of their self generated visual imagery, is to promote flexible thinking by allowing access to both conscious and subconscious levels of thinking; bringing a renewed sense of ourselves as creative beings.

I then focus on the NeverEnding Drawing Machine and Calliope as tools for creative thinking. They aim to promote the creation of personalized and contextualized work by allowing the use of objects as material for creation. Designed as networked platforms, they hope to foster a flexible mind that permits alternative viewpoints where people from all cultures and ages can come together to internalize through their externalizations, learn from and through their and each other's manifestations and exploit the creative potential their environment possesses. In short, a stage to be, share and reflect.

1.1 THESIS OVERVIEW

I will start by providing a theoretical framework, presenting the fields that have inspired this work under the context of reflective learning. I will then attempt to provide a clear narrative of their influence on the design of Pillow-Talk, the NeverEnding Drawing Machine and Calliope as tools for creative thinking.

First I will present Pillow-Talk; a tool to aid dream recall and capture. Background, related work, system design and reflections on an informal user study will be discussed.

Second I will present the NeverEnding Drawing Machine; the motivation behind its design and implementation followed by a user study and its findings. These will serve to situate Calliope as a coherent evolution.

Calliope emerged as the continuation of the NeverEnding Drawing Machine as a portable stage for collaborative storytelling.

I will finish by presenting Calliope, describing the design considerations taken towards its functionality and user interaction as derivatives from the NEDM and provide a detailed description of hardware and software.

The thesis will close with conclusions, followed by support material and references.

Section 2

Background

In this thesis I present Pillow-Talk, the NeverEnding Drawing Machine and Calliope as tools for creative thinking. These tools were designed with mindful consideration of providing space and time for self-reflection. They explore how the artifact, whether a physical object or an object of thought serves as a soundboard for our thought process.

Pillow-Talk focuses on the dream as a personal tool for self-reflection. It is designed as a seamless interface to aid the dreamer in the recollection of the dream, and to be able to capture in detail its visual imagery through voice recording.

The NeverEnding Drawing Machine and Calliope allow the creative use of objects in the environment as material for creation. These systems consist of networked platforms that use a paper sketchbook as their main interface. The NeverEnding Drawing Machine is conceived as a self-contained networked “creation-station,” while Calliope is designed to transform any surface into one. Both hope to offer a stage where to create our own worlds and play our own roles by giving a voice to the objects that surround us. They aim to connect through the intimate act of co-creation.

2.1 CREATIVITY AND PSYCHOLOGICAL HEALTH

"Not all of our most creative children become artists you know."

-Anonymous Russian Man

A mental activity, a product of the interaction between a person's thoughts and a sociocultural context, an idea or action that is new and valuable, or as Winnicott would put it: "everything that happens," I like to think about creativity as who we are and what we do to know ourselves. [Csikszentmihalyi, 1996] [Winnicott, 1971]

Creativity is a human feature that enters all aspects of life, and as such, it is crucial to psychological wellbeing. It is not a way of being, but the way of being.

Winnicott goes as far as stating that "...it is creative apperception more than anything else that makes the individual feel that life is worth living," for creative action demands engagement and participation; it is giving a voice to our human faculty.

Mihalyi Csikszentmihalyi, when talking about Flow, narrates the sense of joy and rapture his subjects experienced when engaged in creative endeavor, to the point that there seemed to be no difference between who they were and what they did. [Csikszentmihalyi, 1996]

Winnicott expresses it in the following way: "...the self is not really to be found in what is made out of products of mind or body, however valuable this constructs. If the artist is searching for the self, then it can be said that in all probability there is already a failure for that artist in the field of general creative living...the finished creation never heals the underlying lack of the sense of self." [Winnicott, 1971]

When we are consumed in what we do, and not in the value of the final product, we come to be and cease to search. Only then can we finally relax into a primordial state voided of judgment. The creative act is a self-actualizing perceptiveness that obliges us to be here now, with no self-awareness. When creativity achieves Flow or peak-experience, there seems to be a general description of transcending self-perception; as if it was that in doing we are, and not in what we do. [Maslow, 1971]

This is true also of play, a landscape which children seem to inhabit and that some of us tend to move out from as we let external demands take priority. Playing absorbs the mind and frees us from constraints by placing us in the illusory, a space where we are able to test what we know and to think in ways we would not have thought of.

“It is in playing and only in playing, the individual child or adult is able to be creative and to use the whole personality, and it is only in being creative that the individual discovers the self.” [Winnicott, 1971]

Playing, creating, communicating, getting into the flow, requires a special setting where we are able to relax and find an echo from a trusted source. Only there and then can we let ourselves be.

2.2 ADAPTATION AND REFLECTIVE LEARNING

“Stimuli, however, do not act upon an indifferent organism”
-Jerome Bruner

Adaptation is understood as the balance between assimilation and accommodation, between incorporating new information into one’s preexisting cognitive structure and changing this structure to accommodate new information. [Piaget, 1954]

Given the speed at which all areas of our culture are changing, adaptation is a constant requirement. Information from the environment is becoming not only accessible but intrusive, reaching us at a speed never experienced and from channels never seen before.

We even plan adventures! We look for the best weather when to take the less traveled road to the highest rated mom and pop’s coffee shop. We take pictures of the menu, the cake, the fork and upload them while we get the check. We rate the spot and make sure it’s known we’ve been there. But are we really there?

It seems as if our time to create and reflect has been compromised by the manufactured need to be present everywhere and with everyone all the time, depleting ourselves from a space and time for intimate interaction.

If adaptation is the product of equilibrium between assimilation and accommodation, it is fundamental for the individual to have a deep understanding of what constitutes him or her as an integral being.

The creative act, creative apperception, obliges oneself to be, exposing rather than hiding our persona.

But creative enterprise seems to be easily mistaken with impulsive action upon desire. Creative thinking requires reflection and the postponement of immediate

action. In John Dewey's words: "There is no intellectual growth without some reconstitution, some remaking of impulses and desires in the form of which they first show themselves." [Dewey, 1963]

Reflection then, is an integral element to learning.

Reflection happens when we synthesize experience into knowledge, when we take distance from what we know, when we take a different perspective and see through someone else's eyes. Reflection is influenced by how we feel as we reflect and happens as well when we share our thoughts and listen. Artifacts provide reflection when we think through them. Reflection secures our identity and calibrates our stance in the reality surrounding.



Fig.1 Robert McKim's interrelation between seeing, drawing and imagining

In creating tools for Creative Thinking, I have tried to consider the way they can provide a time and space for reflection in its social, personal, cognitive and emotional facets.

Asynchronous collaboration that does not demand face to face interaction, but that allows one to take one's time; the ability to contextualize creation by using objects and the environment as material for creation; the possibility of collaborating with people we would not normally do so; the capacity to go back and reflect on the creative process through documentation and the access to different layers of thought have been considered. [Rosenbaum, 2009]

2.2.1 Flexibility in Vehicles and Levels of Thought

Flexible thinking refers to the ability to fluidly switch vehicles of thought and to fully make use of the advantage one has over another. A vehicle of thought is not thought itself, but the way you represent thinking to your consciousness. They can take any shape; from sketching to mathematical models. [McKim, 1972]

Having access to a variety of vehicles of thought offers a much wider spectrum where to look for solutions to problems or derive conclusions from. Having flexible thinking is of great advantage when facing unknown circumstances, as it makes for a resourceful mind that is more likely to be self sufficient and adaptable.

A flexible mind should be able to recognize the different layers at which we operate unafraid of plunging into the subconscious, dwelling in emotions, and bringing it back to rational thought. It should also be able to smoothly transition between vehicles of thought, being capable of making the most of the offerings of each.

Our educational system though, has placed too much focus on language as a vehicle of thought, and while elementary and incredibly powerful, it has taken attention from visual thinking, a fact detrimental when trying to exercise a flexible mind since adhering to one vehicle tends to limit our sources for acquiring knowledge.

Graphical representations are simpler and clearer than words and usually universal. Furthermore, the transition between word to drawing requires clarity of thought and selectiveness.

Moreover, the activity that happens under the conscious level usually uses visual imagery to make itself understandable to the conscious level, otherwise known as autonomous imagery and being the dream the clearest example.

"With its ability to facilitate holistic, spatial, metaphoric, transformational operations, (visual thinking) provides a vital and creative complement to the reasoning linear operations built into the vehicle of language." [McKim, 1972]

Visual thinking is pervasive, it happens when we tie our shoes and set a table; when we walk through a crowd and when we pack the grocery bags. "Perception is an active pattern seeking process that is closely allied to the act of thinking." [McKim, 1972]

Drawing and graphical representations are powerful tools for creative thinking. When we draw, we practice our perceptual capacity, our inner imaginary and our graphical skills to convey. Visual thinking requires us to see, imagine and draw. Drawing also provides record and detail, giving us what memory can't: the power to compare.

Tangible thinking on the other hand, steps out of the perceptual realm of visual thinking and into the object-oriented acquisition of knowledge; touching upon Piaget's constructivism and Papert's constructionism.

According to Piaget, we construct knowledge not only by refining perception, but constructing relationships between objects. Attention to texture and detail found purely in perception not being enough, this features must be situated within the spacial-temporal before having cognitive meaning. Constructivism states that physical manipulation permits understanding by investigating how an object (not necessarily a physical object, but an object of thought) transforms in relationship to itself and to the observer.

Papert, takes the tangible, kinetic at heart saying that knowledge is better acquired when we physically manipulate objects, "Learning by making." The tangible artifact becomes a springboard for reflection by being an item that can be shared. [Papert, 1980]

When we sleep, we create a visual landscape that does not necessarily follow the moral nor the physical rules of the waking reality we inhabit. In this sense, the dream provides an interesting window into object relating. In the dream the dreamer dreams itself, and the visual imagery abides by the aesthetic: the transformation of the thematic by the poetic.

When dreaming we create a stage where we play our own puppet with the added benefit of being able to bend space and time so that it supports the drama. Although for the most part we are unaware that the landscape we inhabit is product of our mind, this is exactly what makes it all the more interesting, since it is not only the narrative that matters, but also the choices made to convey the message. Dreaming goes beyond being a vehicle to self-knowledge. It is also an aesthetic experience. In that I like to compare it to what Turner would say about performance: "... not only a reading of experience, but an interpretative reenactment of experience" [Bollas, 1987]

The dream's visual imagery and the freedom to "bend the rules" whether spatial, temporal or moral when manipulating objects, be they physical or objects of thought, (I was sweeping the clouds to let the sun come through, fireworks melted in the sky like honey drippings, I was hiding inside the skin of a bear, I was walking

on a tight rope over my roofless childhood home, I held a forest in my hand) offers a rich ground where to reflect on our way to construct knowledge, both in the constructivist and constructionist sense. Furthermore, it demands a wake inquisitive mind: “Veiled in enigma, the dream invites curiosity!” [Bollas, 1987]

Pillow-Talk is meant to be a personal tool for self reflection by bringing to conscious awareness the dream not only as a “road to the unconscious” but as an aesthetic lived experience, a product of creative mind common to all and which we go through every night.

The NeverEnding Drawing Machine and Calliope allows us to use our environment and the objects that surround us as material for creation. They offer both a canvas for graphical representation and a stage for object manipulation. Liberated from their function, objects can be used for their perceptive qualities and take upon the function we assign them. We can transform the objects to fit our narrative and while at it, create an object to share with others, regardless of cultural or geographical gaps.

2.2.2 Reflection in Reflexion: Distorted Mirrors

Not only is keeping a flexible mind important to creative apperception, it also fosters empathy by offering different vantage points. When we are able to see the familiar from a different point of view, we create knowledge and appreciation for what we take for granted or promote change for what we dislike.

Victor Turner suggests that: “we should try to find out how and why different sets of human beings in time and space are similar and different in their cultural manifestations; we should also explore why and how all men and women, if they work at it, can understand each other.”

The externalization of an internal thought provides an object for critical contemplation that can be shared, interpreted, re-interpreted or mis-interpreted. In the practice of this we create new modalities of perception that might lead to the individuals re-discovery, as well as cross-cultural commonalities that transcend local realities and question stereotypes.

Collaboration is a performative act that requires negotiation of understanding. Just as we use different vehicles of thought to come to the solution of the same problem, we choose different means to convey message, going beyond words and extending the symbolic repertoire to our sensory entirety. It is not only in the

material but in the use of the material where personal style, moral stance, skill, and aesthetic choices are revealed.

Victor Turner regards the variance in means of expression as a hall of “magic mirrors” in which social problems, issues and crises are reflected, and that, when shifted to a different genre, illuminates different facets, making scrutinization possible and “accessible to conscious remedial action.”

This resonates with what Bollas has to say about the dream experience, calling the dream text a primordial fiction and the dream space a theatre stage for an interplay of self and Other. This all occurring in a setting where thought is transformed to imagery.

Pillow-Talk hopes to capture the detail of this imagery, for the aesthetic choices made reveal as much as the dream narrative.

The NeverEnding Drawing Machine (NEDM) and Calliope on the other hand, provide a stage for networked collaboration. The creative expressions done with them are not limited to graphical representation through two dimensional means. Because one can embed audio, mix analog and digital media and make use of any object; they reflect a much truer personality of the user than by being systems limited to one imposed medium. This diversity invites the user to look into its surroundings for inspiration or for conveyers. Thus, what we express through Calliope and the NEDM is contextualized and personalized.

Calliope and the NEDM are visualized as tools where we can learn from others and ourselves through joint co-creation. This is in the hope of offering a refreshing tool for self-expression instead of self-description, a means that I find conducive to unhealthy and anxiety filled self-consciousness.

Inspired by the Reggio-Emilia Approach, which emphasizes the position of the child in relation to other children, to his or her family, and to the societal and cultural surroundings as fundamental to the building of the child’s identity, it was of crucial importance to make Calliope and the NEDM networked platforms that could help sustain the above statement by being tools for group socialization that made everyone an equal participant by not requiring specialized skills, but instead honing diversity of approaches. [Edwards, et al. 1972]

They were designed to be intuitive so that the user could focus its energy on whatever creative enterprise he or she was undertaking and to make it so that people that would usually be hesitant of interacting with technology could do so, and do so at ease.

By building a bridge over the big divide, we all benefit from enjoying the kind of knowledge that is only acquired when we collaborate with people that we would not usually think we would.

Quoting Victor Turner: “mirror distortions of reflection provoke reflexivity.” [Turner, 1982]

2.2.3 Documentation and Reflection

Documentation is of paramount value for understanding and promoting change as it allows self-correction through perspective. Through it, we can analyze our actions, recreate processes and revisit what informed our creative experience.

Integrating history into the pages of the sketchbook in Calliope was crucial in making it a tool for learning through reflection.

Calliope gives access to the history of any page in the sketchbook to the user without the need to interface directly with a computer. By placing the appropriate tag on the sketchbook, the system displays all the iterations made to that particular page. In this way, we can say that every page retains the history of what has happened to it. This gives us access to the negotiation of actions between collaborators, the evolution of thought process, the coming to understanding and the reaching of agreement.

Documentation instigates interest and reinforces confidence. Through exposure it makes group learning a much more integrated experience. Documentation implies responsibility of action, of thoughtful engagement, of awareness of presence and persistence.

But documentation also gives distance and objectiveness; a new perspective where to reconstruct the past from the inhabited present.

Pillow-Talk allows us to seamlessly record our memory of the dream experience. This recording is saved into a file on one's computer automatically. Having a digital record and eventually a data-base of the dreams had is a powerful tool for reflection, as not only can we access our recollection of the dream, but we can reflect on how the emotional stance from where we do so permeate the way we look at it.

2.2.4 Objects and Performance as Reflection

Whether carriers of thought, companions in life, artifacts of a creative mind or utilitarian goods, objects conform our external reality. We live with them, by them, through them.

Objects serve as bridges between our internal world and the external reality we inhabit.

Material Culture, Object Performance and Evocative Objects all refer, through their particular lens, to our relationship with physical objects, to what we do to them and what they do to us. I refer to these three areas for I believe they encompass three relevant perspectives: the societal, the individual, and how the individual reflects on, and is informed by the societal through performance.

From a societal stance, Material Culture offers an insight into the nature of our cultural and emotional propensities as a society by studying our relation, manipulation, and perception towards, with and from objects. Material Culture then, is a manifested representation of a cultural identity.

From an individual perspective, Sherry Turkle in her "Evocative Objects" book, reminds us of our emotional relationship to objects by "focusing not on their instrumental power, but on them as companions of life experience." She talks about the property of objects of bringing together thought and feeling: "we think with the objects we love, we love the objects we think with." [Turkle, 2007]

Further more, Turkle suggests that we all could find common ground in everyday experience if we focus on objects.

Objects then, are presented as vehicles for human understanding.

Used in performance through out history; whether as masks and puppets or as abstract shapes, in the performative, objects are offered a stage, given a voice. We talk through them and let them talk for us.

The performative allows us to see not only a reading of experience, but an interpretation of it. As Jean Rouch would say: "fiction is truer than reality"

Frank Proschan defines the "performing object" as the "material images of humans, animals or spirits that are created, displayed or manipulated in narrative or dramatic performance. [Bell, 1999]

Object theatre as performance practice though, is usually regarded as making use of objects not designed specifically for theatrical purposes and that usually have a utilitarian function outside the stage. [Allen, R. 2009]

By lacking a conscious performing ego, the object is either allowed to perform as itself through its own objectiveness, or endowed with symbolic powers by performer and or audience. Once placed on a stage, in the best of cases, they become as important as human actors. The performing object then serves as a lens into the way we refer to the culture it performs.

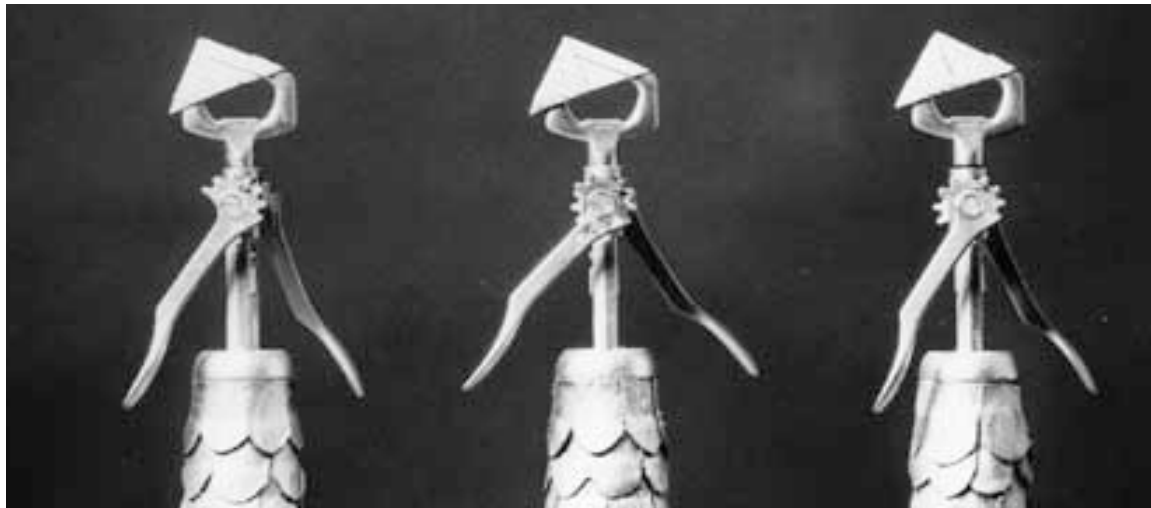


Fig. 2 Peter Ketturkat's "The Crazy Kitchen Crew"

Calliope, as well as the NEDM offer a stage for objects to become part of the user's narrative. Objects become performers through the animism of the user, and users become performers by using objects to tell their stories. The choice of objects is not less important. While sometimes the narrative is driven by the object, in others it is the object that serves the narrative and yet other times, the objects are placed just to be recorded, to embed the identity of the user in one way or another onto the narrative.

As illustrated in following user study, there were cases of tie-dye T-shirts representing sunsets, open wallets, business cards, jewelry and watches placed arbitrarily, and even Silly Bandz®, an amazingly popular item among kids and here defined by one: "they are rubber bands that take shapes of animals and people and objects...but they are cooler than rubber bands 'cause they take shapes..."

Not limited to objects around us, the body became a popular object itself.

Stamping hands and faces, and changing the way they look by altering the digitalized self-image by drawing over it or by accessorizing it with objects in ways mostly not permissible in real life was an amazingly amusing thing to do.

Hyun-Yeul Teresa Lee in her thesis “Storied Objects” explores the inclusion of time in the design of objects, extending their form and function to include the memory of their experience by outfitting them with sensors that are able to record the experiences had by them and through them. She focuses on what the object itself would find relevant, rather than on the experience the user has of the object. [Lee 2007]

2.3 EXPERIENCE IN EDUCATION

“Education must, then, be not only a transmission of culture, but also a provider of alternative views of the world and a strengthener of the will to explore them.”

-Jerome Bruner

We could define experience as anything and everything undergone, but if we also acknowledge that every experience affects the quality of subsequent experiences, we could then consciously try to focus on the promotion of experiences that would be beneficial both in nature and in furthering constructive experiences.

John Dewey talks about experiences that are genuinely educative when they promote, instead of arrest, the acquisition of more beneficial experiences. An experience, to have educational value, should arouse curiosity, strengthen initiative and set up desires and purposes.

Since we can't talk about personal experience as an isolated event and given that experience is a social construct heavily dictated by the environment it takes place at, it is of crucial importance not only to try and provide spaces that are conducive to beneficial experiences; but to have a resourceful mind that will be able to recognize and extract from it's surroundings, physical and social, whatever it can contribute to the building of worthwhile experiences.

One can only exercise a flexible mind and a resourceful eye in the present; and being in the present requires an engaged individual. Flexibility, resourcefulness and engagement then, seem to be indispensable traits when confronted with a world that is neither predictable nor does it stand still. “Only by extracting at each present time the full meaning of the experience had are we prepared to do the same in the future.” [Dewey, 1963]

Calliope was designed to support the inclusion of personal experience as an integral part of creative learning and to prime the acquisition of future positive experiences by being a tool for cross-boundary collaboration that promotes the individual's capacity to re-contextualize their environment to fit their creative endeavor, engaging the individual in it's present.

Section 3

Tools for Creative Thinking

Pillow-Talk is a self-reflecting tool, where the dream is the personal aesthetic creation, the self-distorted mirror image where to reflect upon.

The NeverEnding Drawing Machine and Calliope take the dialogic with the other as the echo where to evolve one's understanding from.

3.1 PILLOW-TALK

"Complete health is being available to yourself at all levels."

-H. A. Maslow

In the fear of falling into a conception of creativity as something relegated to the "artistic type" or that the finding of the self is only achieved when creating work that is universally recognized as skillful or beautiful, I am resorting to the visual imagery that is created every night, by all of us in our sleep as a universal, primary source of self-reflective, creative thinking.

Maslow talked about two types of creativity: primary and secondary. He referred to the secondary kind of creativity as the one exerted when working with others and with the sources of others, and of primary creativity, he said, it is the one that resides in the "depths of human nature" not known to most people not only because it lays so deep, but because: *"This is something that we not only don't know about but that we are afraid to know about."* This primary creativity, he continues, is a heritage from every human being; a common and universal thing and visibly present in healthy children but repressed in most adults, only accessible if one digs deep. [Maslow, 1971]

Creative thinking needs a place and a time where relaxed attention can be obtained.

Sleeping allows for the allocation of such. Our minds are engaged while dreaming, processing information and offering an immense landscape where flexible thinking is practiced towards bringing insight, solution or resolution to waking life concerns.

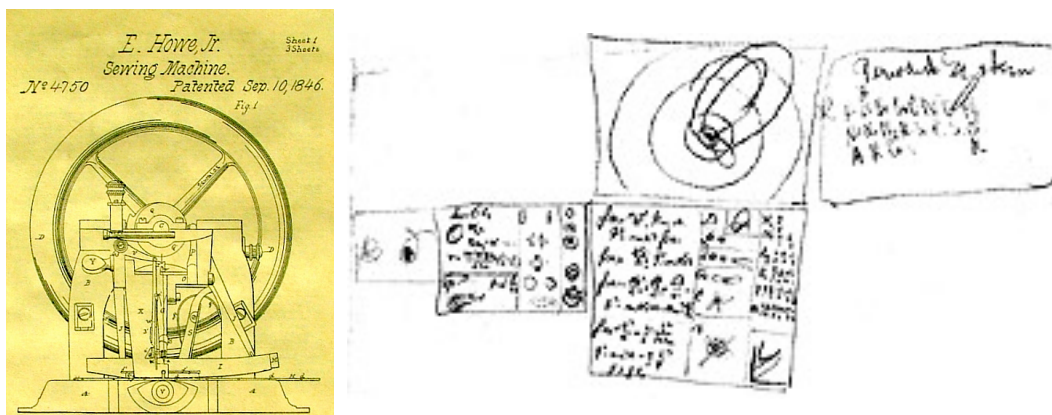


Fig. 3 Howe's sewing machine and Bohr's research notes for atomic theory, both came up in dreams

Not limited to rest and nurture, the dreaming mind has provided a wealth of inventions and discoveries that have been brought about by the ability of creative folk to move between conscious and unconscious thought seamlessly. Penicillin, the sewing machine, the atom structure...they all came about in the dreams of engaged minds.

Not only is recalling the dream the first step, but being able to find the solution in the dream is something that is not easily attained unless we have a conscious creative and flexible mind, as solutions are sometimes presented in a guise that might not be easily deciphered by the physics of waking life.

Moreover, and as briefly touched upon before, Christopher Bollas added to Freud's vision of the dream as a veiled unconscious which discourse was to be discovered by "translating its iconography into word," the idea of the dream as an "intrasubjective rendezvous", where we are both dreamer and dreamed, the object of the subject in a stage created by the aesthetic consideration of transforming thought into fiction. [Bollas, 1987]

Pillow-Talk attempts to make use of ubiquitous computing devices with reality-based interaction. Dream recall does not come easy for most people; most advice for recollection suggests keeping pen and paper close by. But sitting up, turning a light on or just simply moving is counterproductive to reminiscing. Stillness is crucial for recall, as even a slight movement is enough to make the dream evaporate from ones mind.

Pillow-Talk provides a seamless interface to capture dreams minimizing the risk of distraction by embedding a recording module into the pillow. To record a dream, one simply has to squeeze the pillow and start relating. Once captured, the dreams are saved onto ones computer for later use in whatever way one might see fit: for inspiration, analysis, self-reflection or mere curiosity. As an addition to capture, my colleague David Cranor designed a playback device, the Jar, designed to elude of fireflies trapped in a jar. [Portocarrero, et.al, 2011]

Once a dream has been recorded, the Jar flickers while the recorded dream is being transmitted to it, and glows once it has been received. A switch between the lid and the lip of the jar is "opened" once the lid is twisted off, prompting playback from a speaker at the rim of the jar's neck. The Jar provides a tangible visualization tool, and makes use of the affordance of the jar the way to retrieve the recording.

The digitized dream allowed by Pillow-Talk, unlike a dream diary, gives the user the potential to analyze dreams over time, qualify and quantify themes, characters and emotions.

Speech to text recognition could allow data analysis, revealing common themes not only presented in the particular user's dreams, but among different users. Pillow-Talk could serve as a powerful tool to bring further insight into the fears and desires of a determined culture or generation as interpreted through their dreams, and the aesthetic choices made to convey them. As Joseph Campbell puts it: "Myths are public dreams, dreams are private myths...dreams talk about permanent conditions within your own psyche as they relate to the temporal conditions of your life right now." This could potentially relieve any sense of alienation by illustrating that every individual problem should be seen in reference to the human situation as a whole. [Campbell, 1988]

Pillow-Talk sparked interest for unexpected uses in various fields. Image Rehearsal Therapy (IRT) is a practiced and successful technique to treat recurring nightmares in Post-traumatic stress disorder (PSTS) victims that requires the dreamer to reframe the nightmare into a positive dream by imagining and repeating the desired outcome before going to sleep. [Greiger, et al. 2006] [Barry 2006] [Talbot 2009] [Kershaw 2010]

Other studies suggest that nightmare recurrence diminishes when the dreamer is conscious of sleeping under observation. Pillow-Talk could be said to be an inhibitor of bad dreams and a primer for recall.

3.1.1 System Design

Pillow-Talk is a system composed of two objects:



Fig. 4 Pillow's switch recording. Patches of conductive fabric designed after the "dream creatures" of a 9 y.o. girl

The Pillow, a seamless interface which captures the users dreams and musings via embedded interaction; and the Jar; a tangible visualization and playback device.

The most common advice to the dreamers that want to obtain and exercise recall is to keep a dream diary by their bed. Nonetheless, it has been noted that there is a link between dream recall and muscle memory, making movement detrimental to dream recall. To write, most people need light, disrupting the otherwise moment of clarity that comes when staying still and in darkness. [Barrett 2003]

To start recording on Pillow-Talk, all the user has to do is squeeze the corner of the Pillow. Recording will stop when letting go. This allows for an uninterrupted, detail rich, free flowing narration. The recording will then be transmitted to the users computer and Jar and saved for later recall.

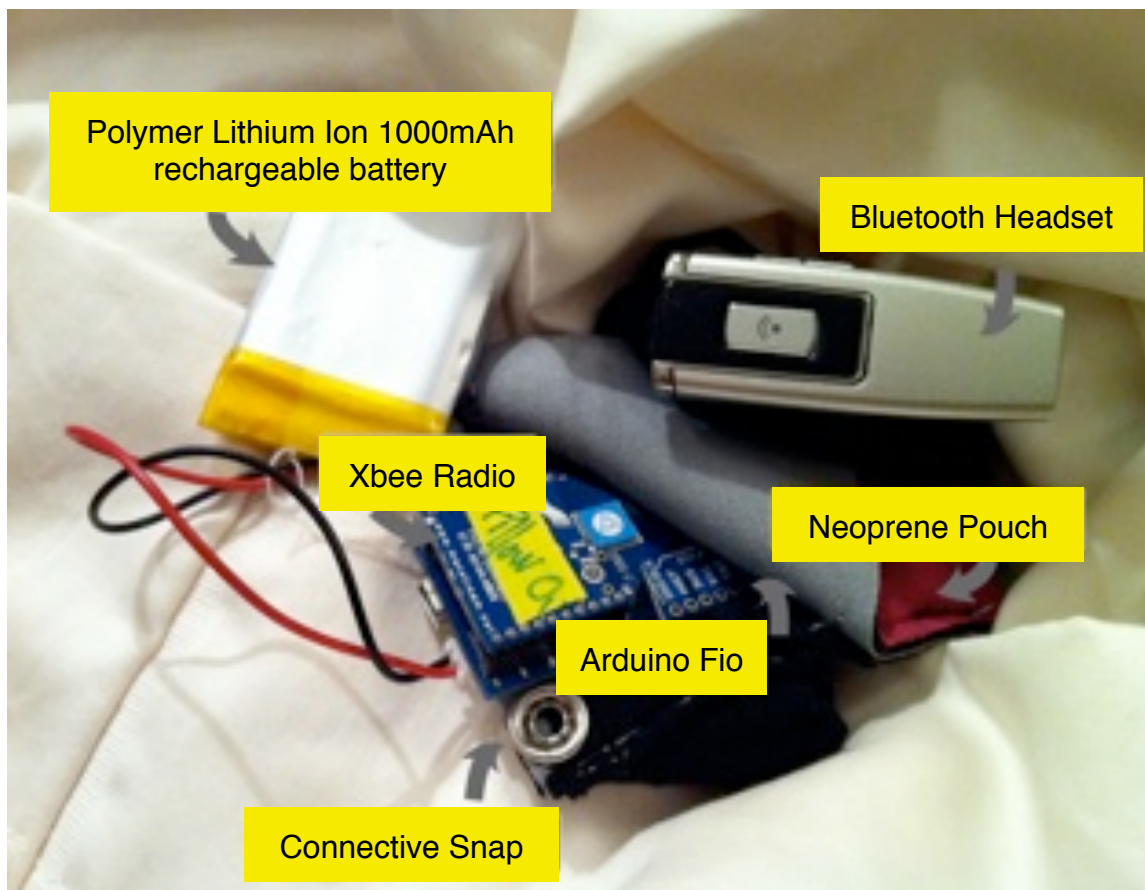


Fig. 5 Module inside the Pillow

When a dream is being transmitted, the Jar starts flickering, once received in glows. To listen to a dream, one simply has to open the Jar and the speaker in its neck will play back a randomly selected dream.

Important factor when designing the system was to have a seamless user interface that took advantage of the affordances of objects without adding any other kind of required interaction. Pillows afford squeezing and jars are used for storage requiring the twisting of a lid to retrieve them.

HARDWARE: *Pillow*

The Pillow is a regular pillow with a sewn switch made of super soft conductive fabric.

This is connected with snaps to a removable module encased in a neoprene pouch containing an Arduino Fio and an Xbee Radio, a Bluetooth wireless headset paired to the users computer and a Polymer Lithium Ion 1000mAh rechargeable battery for power. The design of the fabric switch and only component exposed to the user was based on the renderings a 9 year old made of dreamed creatures, enhancing the personal nature of a pillow.

We made the board detachable to be able to adapt it to any pillow and permit the washing of the pillow-cover.

FIRMWARE: *Pillow*

The Pillow's firmware is simply the closing of a switch by having both pads of conductive fabric touch each other. This sends a signal to the computer to start recording.



Fig. 5 Glowing Jar with dreams stored and Jar open, playing back a dream

HARDWARE: *Jar*

We used a regular Mason Jar for its familiarity.

The neck of the Jar conceals a 3D printed module that encloses a custom made PCB, a Polymer Lithium Ion 1000mAh rechargeable battery and an ultra thin speaker. The lid and neck of the jar has two thin strips of copper tape, and the lid itself has a small piece of the loop side of conductive Velcro®. This serves as the switch which is open or off when the lid is on.

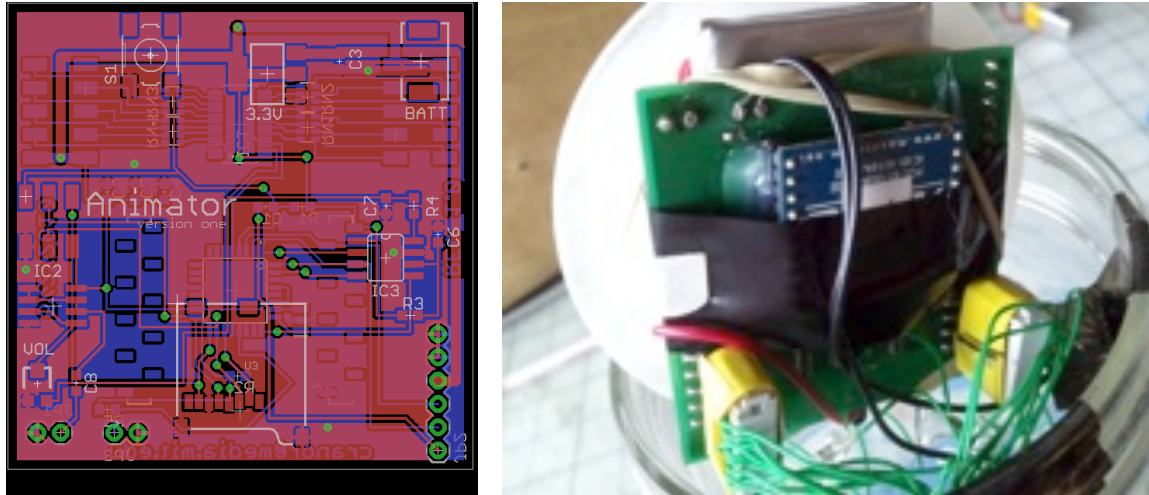


Fig. 6 Jar's Animator

The costume made PCB integrates a MAX7317 16 channel LED driver and an XBee wireless radio with an Arduino compatible development board and Arduino Wave Shield for audio. Sixteen amber colored LEDs are connected to the bottom of the board and dangle into the jar. Their leads are bent to simulate wings and filled with silicone.

FIRMWARE: *Jar*

The Jar's firmware does the following:

- ▶Checks the serial port of the host computer to see if it is sending a sound file over wireless. If so, record it and save it to the SD card.

- ▶Checks the lid switch to see if the jar has been opened. If so, play back a random file.

- ▶Twinkle LED's when transmitting, glow when received.

SOFTWARE

The software is a simple sketch made in Processing that captures audio when the Pillow is squeezed, saves it onto central computer and transmits it to Jar for playback when lid is opened.

All the devices communicate to each other via XBee radios.

3.1.2 Related Work

Persuasive technologies expose the individual to otherwise unrevealed knowledge about themselves in order to change their habits and attitudes. The data though, is usually used by third parties and mostly applied to management, sales, politics religion and public health. Nonetheless, it is an interesting field in that it exposes aspects of the individual that usually happen under the conscious threshold. [Fogg, 2002]

The Persuasive Mirror gathers data from the user's habits and displays a portrait of what he or she would look like in the future if such habits persist. It is interesting in that it gives the user continuous feedback based on the users own behavioral data instead of having a third party make use of it. [Del Valle, Opalach, 2005]

Relational Machines are technological artifacts that interact with people on an ongoing and extended basis to the benefit of its user.

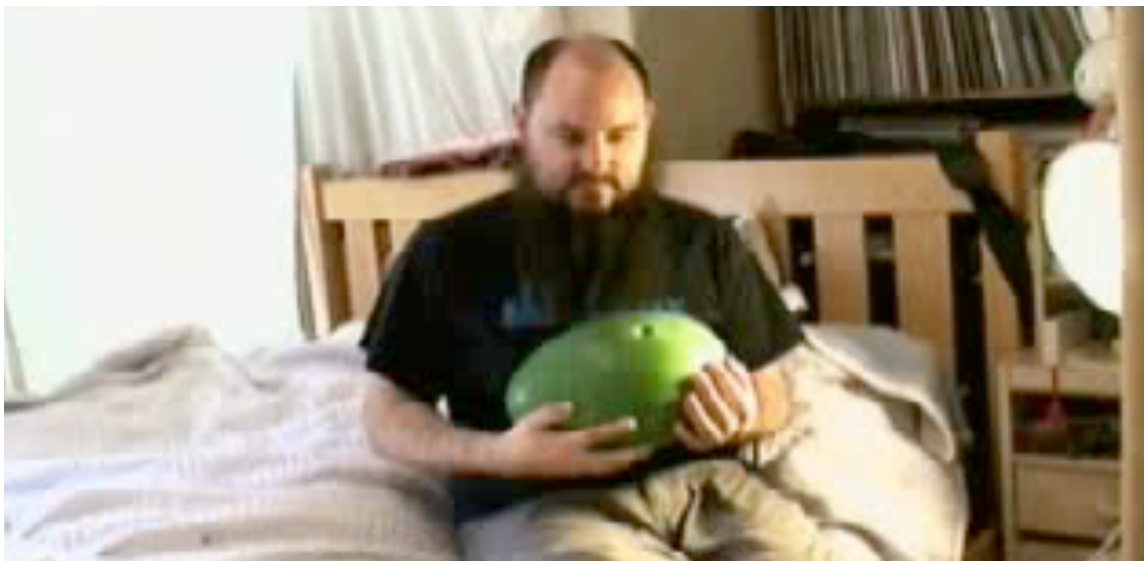


Fig. 7 Kelly Dobson's Omo

Kelly Dobson's Omo is a relational machine that reveals the visceral and emotional aspects of breathing through imitation. Breathing is one of the few bodily functions that, while usually happens under unconscious control it nonetheless can be consciously controlled. [Dobson, 2010]

Francois Pachet's talks about the creation of content technologies that can enhance individual realizations by establishing inner dialogs through which personal content could emerge. Reflexive Interactions, which he describes as: "...interactions in which an object has to be constructed (e.g. a melody, a taxonomy, etc.) not directly through a traditional construction scheme, but indirectly, as a side-effect of an interaction taking place between a user and an image of himself/herself, typically produced by a machine-learning system. Technically, this image is necessarily going to be imperfect, for many reasons, including the intrinsic limitations of machine-learning systems, but it is precisely this imperfection which is going to produce the desired side-effect." [Pachet, 2008]

There is a myriad of projects that make use of the intimate qualities of a pillow as an interface. Here are just a few examples.

The Dreaming Pillow is a beautiful project exploring dream imagery taking the pillow as a canvas. Using capacitive sensing, it is reactive to touch: stroking the pillow enables the user to delve into the oniric landscape. [Leung, Oswald, 2008]



Fig. 8 The Dreaming Pillow (L' Oreiller Rêveur)

move.me uses pillows as an intimate input and output interface of adaptive ambient technology. [Nack, et al. 2007]

3.1.3 Exploration

We conducted a pilot study to identify the benefits of our idea and the implementation of the design. This pilot study helped identify the benefits of using Pillow-Talk over a paper-based dream diary.

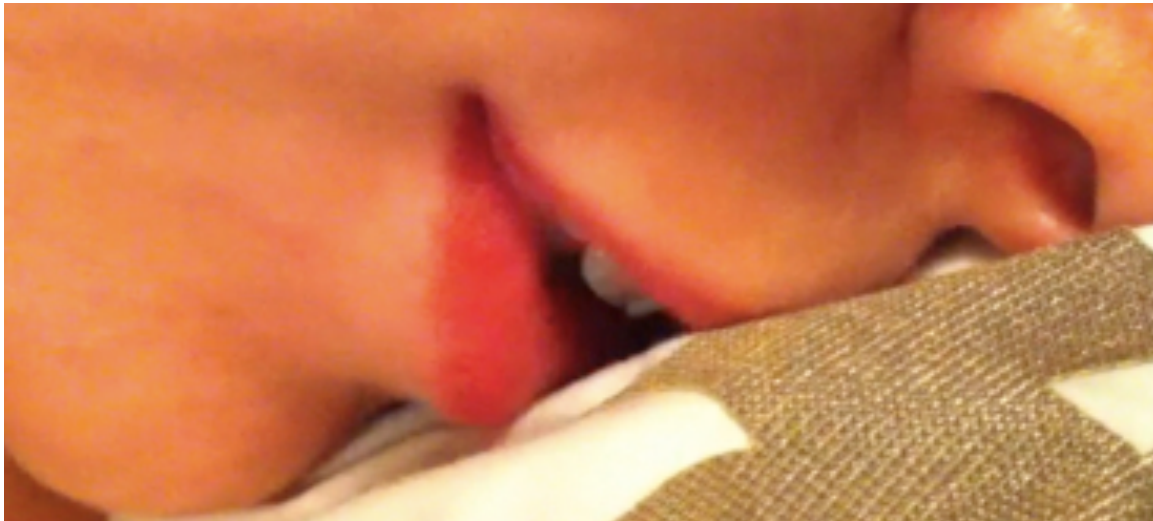


Fig. 9 User Interaction with Pillow-Talk

We considered three cases: a user who normally remembered his dreams but fails at writing them down, a user who rarely remembers a dream and a user who remembers his dreams periodically. We asked each individual to be in possession of Pillow-Talk for 3 to 5 days.

In most cases, having a pillow specifically designed to record dreams onto improved remembrance by serving as a primer.

Transcript:

“I think dreaming is a tool of thinking...it is great to be able to remember your dreams and work backwards through the images that come from feelings or thoughts that get put behind everything else during the day and see what inner feeling or thinking led you to dream that...”

One user misplaced the Pillow while sleeping and thus failed at accessing the switch and recording. Another design issue mentioned was the need to turn on the device before retiring to sleep.

While one of my biggest concerns while designing Pillow-Talk was the need to talk out loud since I thought it was unnatural, I was pleasantly surprised by one user

being actually happy that that was the way of interacting. She mentioned it was while talking that she felt more capable of remembering detail.

Transcript:

“...after I get out of bed and I open my curtains and I start my day, I forget what it was that I dreamt, and there is no way to really go back and get that in the kind of detail that it is in when I first wake up, so it was nice to have the Pillow to tell that to...”

She was happy to know the recording was stored, that she could share it and listen to it whenever she pleased.

Another user alluded to the Pillow as a companion in how it provides the time and space of trust where we feel safe to relate our nightly musings in the way a sleeping partner might, also touching upon talking outloud in order to record:

Transcript:

“...often when we have sleeping partners we tell them our dreams and we can say that before we move out of bed...but when the sleeping partner isn't there, this kind of Pillow becomes like a companion rather than something just to record onto.”

The Jar proved to be a liked playback object, stimulating further use of the Pillow and adding value to the user's perceptions of their unconscious wonderings. The randomized playback was sometimes welcomed, while other times it proved frustrating when having the desire to listen to a specific dream.

3.2 THE NEVERENDING DRAWING MACHINE

3.2.1 Beginnings

The NeverEnding Drawing Machine was made by Michelle Chung from the Harvard Graduate School of Education, Sean Follmer from the Tangible Media Group, David Robert from the Personal Robots Group and myself; four different minds wrapped around the task of making a tool for interactive Storytelling. Interests and inspiration ranged from Lautreamont's phrase: "Poetry must be made by all, not by one," the Surrealist's parlor game Exquisite Corps to Gianni Rodari's "The Grammar of Fantasy." [Portocarrero, et.alli 2010]

We wanted to make a tool that would blend analog and digital media seamlessly; a multi-user system for performance; an augmented sketchbook.

Our initial explorations involved the making of the first two "creation-stations." Each one integrated a computer connected to the internet via ethernet, a webcam and a projector.

A quick patch made in TouchDesigner was able to live broadcast what one creation station's webcam was capturing to the collaborating station.

This first fast prototype was useful in showing us the potential of the system making it clear that collaboration between two creation stations was indeed quite fun. It also provided insight about the challenges we faced and the limitations we had to work with.

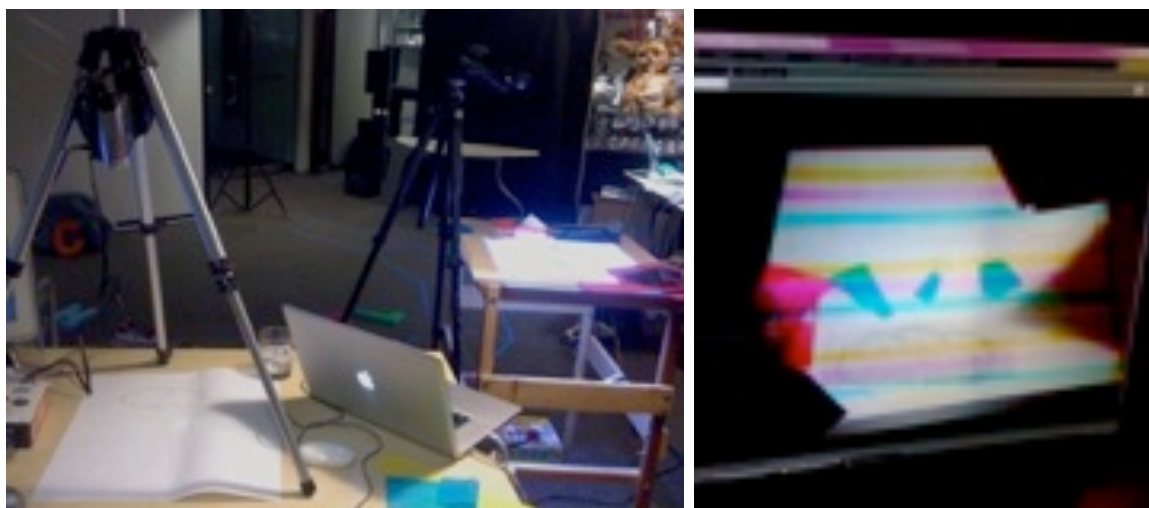


Fig. 10 Explorations towards the "creation-stations."

We were successful at bi-directional real-time streaming, though given we were using two different computers, the frame rate was unequal. We also were able to record a video loop, but we had not thought about how to make it accessible to the collaborator.

Our initial idea was to use a rear projector and to project to a projection table. This would have made a self-integrated table and gotten rid of the casting of shadow that projecting from the top would have implied. We also thought about using a touch screen instead, making it even more compact. While this would have solved many issues, it would also have changed the nature of the project completely, drifting us from the initial idea to use a familiar analog interface which affordances indicated the interaction mode. It would also have not allowed the integration of objects, when in fact it is the ability to do so that became a trademark and fundamental to the development of the current working prototype. Much of the current design interaction was defined after these initial experiments.

Many problems also became evident after these explorations. The webcam's capture rate and the projector refresh rate were different, giving us RGB interference patterns, while the software was quite demanding on hardware requirements. For the system to run smoothly, we needed fast graphics cards and matching equipment on both sides.

3.2.2 NEDM: The First Working Prototype

The Never Ending Drawing Machine works through the integration of a projector-camera system, a paper sketchbook with fiducial markers, custom made software to capture and layer content, and a capture button attached to an Arduino board.

The software is written in TouchDesigner, a visual programming environment.

The Arduino listens for a button press and communicates via serial to TouchDesigner.

The webcam locates the corner-pin coordinates of the sketchbook and re-projects it over itself. [www.arduino.cc]

A second webcam detects ReacTIVision's fiducial markers placed on each book page spread. [www.reactivision.sourceforge.net]

The final projection is a composite image formed by the pre-made, background content (unique per book page spread) as well as the latest camera snapshots from both (or all participating) creation-stations.

The creation-stations are networked to each other and access each other's file systems to read images and sounds.

Additionally, metadata is sent over the network to inform each participating creation-station of each other's current page. All of the applications are built in a scalable, modular structure to support the expansion of the project based on site-specific needs.

HARDWARE

Each of the NEDM creation stations is composed of an ultra-short throw projector, two webcams with microphone integrated, speakers, a micro controller (in this case an Arduino board), a big arcade push button, a computer with a fast graphics card and a large sketchbook.

This are all integrated onto a costume made table top to accommodate the sketchbook, projector and push button, as well as have room for pockets that contain all sorts of craft material, and a camera mount with the appropriate height to both be able to capture the full sketchbook and read the fiducial marker on each page.



Fig. 11 "Creation-Stations" co-located

The tables are on wheels and were designed to fit together if co-located, and to seem like the part of two parts of one unit when apart.

Each of the cameras serves a different purpose, one is used to capture the created content while the other is used for page tracking. The ultra-short throw projector also serves as the lighting source.

The state of each creation station is visually indicated on the table as well as broadcast to the network as metadata so you and your collaborator are aware of each other's general activity.

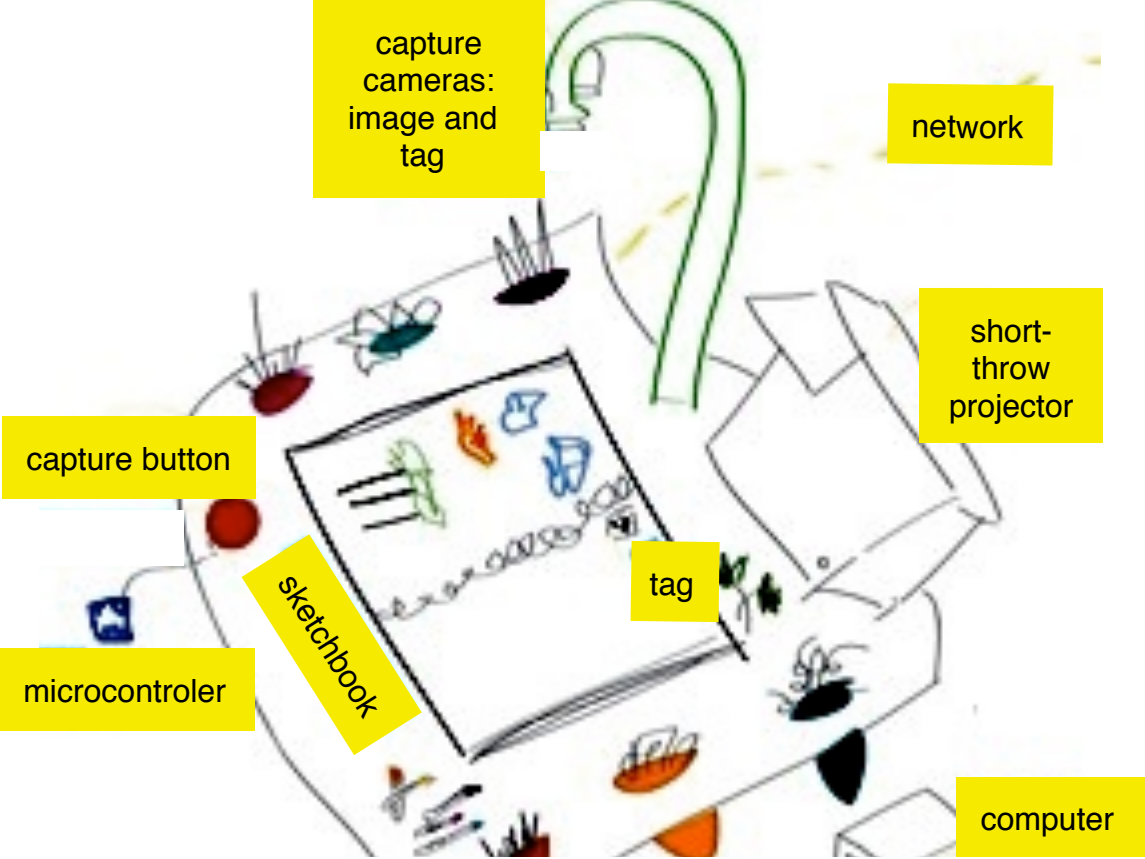


Fig. 12 “Creation-Station’s” components

SOFTWARE

The NeverEnding Drawing Machine was programmed using Touch Designer FTE (free-thinking-environment) and integrates serial coming from an Arduino board and fiducial tracking using ReacTIVision via OSC (Open Sound Control)

The system was built on a scalable architecture, so that multiple creation-stations could be networked, co-located or at a distance.

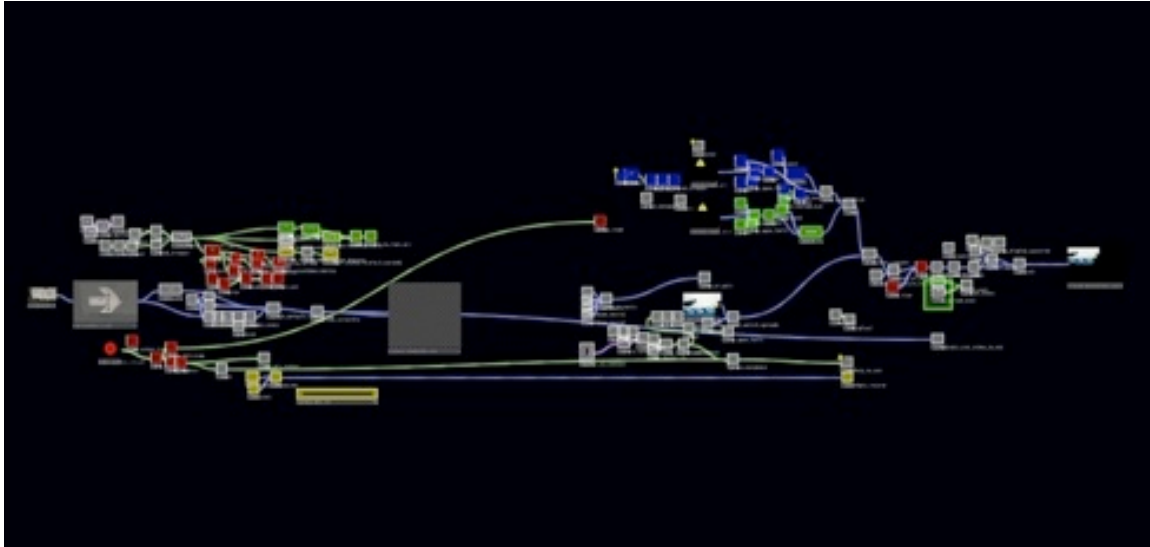


Fig. 13 TouchDesigner patch for the NEDM

The inputs of the system are:

- ▶ Live video
- ▶ Fiducial Tracking
- ▶ TCP/IP messages
- ▶ Button press via serial from an Arduino board

The live video input is run through a homography process, determining corner pins and correlating them to the ones of the sketchbook, fitting the image.

The second camera of the system reads the sketchbook's fiducial tags using ReactIVision and sends the tag's ID's via OSC. Touch Designer then knows what image, sound or animation corresponds to each page, synchronizes the sketchbooks and projects accordingly.

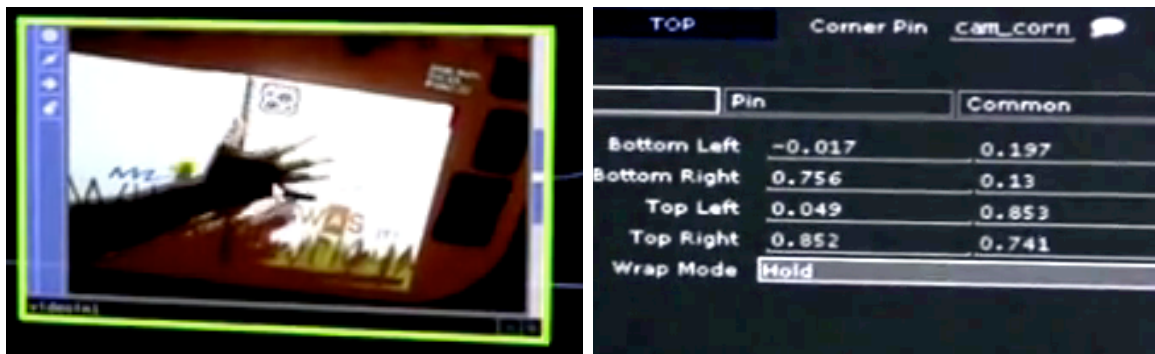


Fig. 14 Live video input and corner pinning



Fig. 15 Boy creates a spread using toys on the NEDM



Fig. 16 Boy snaps! his drawing to send it over to his friend's sketchbook

When the button connected to the Arduino board is pressed, it means a picture has been taken. The Arduino communicates through Serial to TouchDesigner, which in turn layers the newly captured image with the previous content. The networked "creation-stations" access each other's file systems to read changes and update. Metadata is sent over the network, informing each other of their current page.

3.2.3 User Interaction

The NEDM was designed to have little to no learning curve. Following the notion of Reality-Based Interaction, we hone the affordances provided by a sketchbook as the principal mean of interaction. [Jacob et alii.]

The NEDM allows personalized creations using objects and materials in addition to pens and pencils that can be projected on a sketchbook, layered and edited to make a dynamic book created by the users themselves.

To make use of the NEDM, the user simply has to design a spread making use of any material that she needs and taking all the time needed. Once done, she simply has to press the big red button. By pressing the button, she captures what she has created and projects it back onto her sketchbook as well as onto the sketchbook of her collaborator, be it co-located or at a distance. She then can choose to turn pages and create a story, edit what she has done or layer over whatever her collaborator has sent her. A small display alerts her of her page number as well as that of her collaborator, this allows her to synchronize and work on the same spread, or not.

3.2.4 Sketchbooks

To scaffold the interaction with the system, we created a couple of sketchbooks whose digital content was designed to guide the user on the potential of using any materials to create a story.

I attempted to take scaffolding through Rodari's lens and focus on the role of the "teacher" as an "animator," "and adult who is with the children to express the best in himself or herself, to develop his or her own creative inclination, imagination and constructive commitment." [Rodari 1973]

These sketchbooks are composed of a series of still images, animations and sound recordings that are used to fill each page of the beginning of the sketchbook, leaving the rest of it blank.

We created two different books with different two themes: Twice Upon a Time and Day of the Dead.

Gianni Rodari's "The Grammar of Fantasy," was a pivotal source of inspiration for the creation of both books. In his book, he "examines the way in which people can collaborate in imaginative play" by presenting a series of wonderful techniques for the imaginative creation of stories.

For the second book, we attempted to provide a theme that had a strong cultural context. We created a book inspired by the Mexican Day of the Dead.

We are currently working on creating a website where users can upload their own digital media to be shared and projected in whichever sketchbooks choose to.

So far, we do not have a way to upload digital content without having to interface directly with the computer.

Sketchbook: *Twice Upon a Time*

For the creation of this book, we took inspiration from El Lissitzky's "About 2 Squares," a book dedicated "to all, to all children."

In this book, Lissitsky invites his audience to make the leap from passive reading to active construction. [Lissitsky 1922]

Each page of Twice Upon a Time contains either an animation, a still image or sound. Some of the still images include sound as well.

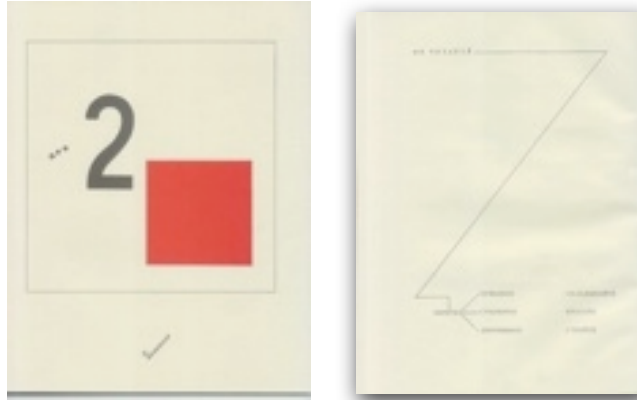


Fig. 17 El Lizzitsky's "About 2 Squares." Cover and Instructions: *Don't read this book Take -- paper. . . fold...rods . . . color...blocks of wood . . . build*

The book has no discernible narrative, except for certain elements being repeated along the pages.



Fig. 18 Stills from "Twice Upon a Time"

The intention of designing the book as such, was to see if by creating digital content with the same material as the one provided, users would feel incited to make use of the material and further look for new material that would fill their creative need.

Sketchbook: *Day of the Dead*

This book was created very much with the same intentions in mind as *Twice Upon a Time*, with the difference of trying to incorporate cultural context into the content. *Day of the Dead* is one of Mexico's most folkloric traditions.

The book is composed of animations and still images made with cutout illustrations of skeletons dressed in dance attires and hats.



Fig. 19 Stills from “Day of the Dead”

This were designed by one of Mexico’s most famous engravers, Guadalupe Posadas. His engravings are iconographic of Day of the Dead.

The animations show the skeletons performing quirky situations; such as serenading, or asking each other for a dance.



Fig. 20 Engraving by Posadas about Day of the Dead

Tissue paper cutout or “papel picado,” originally used to decorate altars for Day of the Dead, is used also for decoration in the animations.

This book also made use of little three-dimensional figurines, hoping to incite people to look not only for flat objects.

3.2.5 System Limitations

Limits: *Hardware*

The NEDM never took into consideration the difference in height between children and adults. The height was the one of a standard table, making most children have to stand on a chair to reach the top of the sketchbook. The ability to use of objects also promoted a lot of physical movement around and on the table, and neither the table nor the arm holding the camera were steady enough. Just a slight push would usually provoke calibration errors. This implied the camera failing to read the tag, which in turn would fail at displaying the appropriate image.

The projection was made to fit the sketchbook by pinning it to the corners of this. A white projection square had to be added as an overlay to the projected image, so that the fiducial would not be overshadowed. Moving the sketchbook would cause the system to stop working properly.

The ultra-short throw projectors were costly and there was no attention paid at securing them to the table. There had to be constant monitoring of the users to make sure the projector would not be tumbled.

The system had little leeway for actual manipulation without direct supervision. While the interface was intuitive to use, once there was a problem, there was no clear reason to the user of what might the problem be or how to fix it. It usually seemed like a software problem, when in reality it was a simple but overlooked hardware design failure.

Because objects can be used, users were fast at trying out taking pictures of themselves at work, of using their own hands as images, or at creating complex compositions that needed the use of both their hands to hold. When this was the case, users had to resort to the elbow or to ask for a passerby to press the button for them.

Limits: *Software*

The NEDM was entirely programmed using TouchDesigner. While being a powerful environment with great rendering and compositing resolutions, it also provides big limitations.

It only runs on Windows OS, there is no support provided but through the Forum, and being a programming environment aimed at designers, it requires most people to learn a new environment.

For a fiducial tag to be read, there can't be anything obstructing it from the camera. Much of the content of the book occupied the whole of the page, so that when it was projected onto the sketchbook, the tag would be covered by the image's projection. In order to give it a permanent clear space, a white projection square had to be overlaid over the original intended projected image and while this proved a fast solution, it also forced the sketchbook to be in the same exact spot for the system to work.

3.2.6 Related Work

Our work is motivated and inspired by a number of projects from the realm of Computer Supported Cooperative Work (CSCW).

Kidpad allows for children to collaboratively draw stories together using onscreen zoomable interface [Hourcade 2002]. However we are more interested in how we can allow users to bring in physical media across a distance.

Clearboard allows users to draw on a shared surface at a distance while maintaining the ability to share gaze and other gestural interactions [Ishii, Kobayashi, 1992]. However because of its vertical slant and real time capture system, it does not allow for the use of other media such as objects or paint, only drawing.

VideoDraw and Double Digital Desk both allow for two remote users to share objects and sketches, on two remote physical tables with the use of camera and projectors [Tang, Minneman, 1990] [Wellner, Freeman, 1991] Similarly, Sharetable applies this paradigm for remote collaboration between parents and children [Yarosh et al. 2009]. However these examples do not have "memory," they only display what is currently on the other side – you cannot easily copy objects or drawings to keep them on screen.

Our system also introduces the book metaphor as a way to have more spatially multiplexed content, and also our focus on asynchronous capture can provide for more artistic content to be produced.

We also draw on work from the field of tangible and augmented interfaces for children.

Jabberstamp allows for children to add audio to specific locations in drawings, however it is not shared across a distance and only allows for drawings as input – not objects [Raffle et.al 2007]

Similarly, Stifelman's work allows for users to add audio to any physical document [Stifelman 1996] Our system allows for audio input, but only on a page by page basis.

IO brush is a beautiful tool that explores how we can use objects in the real world as a pallet from which to paint with [Ryokai, 2004] However we focus more on compositions and an augmented form of collage, than augmenting the paint itself. Additionally, Calliope is a networked system interested in facilitating collaboration between people that would not usually.

3.2.7 Evaluation and Findings

In this section, I present the methodology and conclusions of a study that was performed to gain insight into the potential of the system.

Since the system was designed in the hopes of blurring the boundaries that prevent cross-cultural and cross-generational collaboration, there was no age discrimination, no need for English knowledge, nor was experience with computers or systems of any kind required.

Users ranged from kindergardeners to grandparents; from photographers to mechanical engineers to full-time mothers. A wide range of ethnicities and socioeconomic backgrounds were represented.

Evaluation: *Study Goals*

Before venturing into the design of the current system, it was important to know what the design parameters were that worked in supporting collaboration, in allowing concentration, and in inviting the user to interact with the world around her.

The investigation centered around the following questions:

- 1.How does this system blur any boundaries for collaboration?
- 2.What is the learning curve for the user?
- 3.Does the system invite users to interact with their surroundings and bring it in as material for creation?
- 4.Is the system supporting the user's creative endeavor?

Evaluation: *Study Format*

Users were invited to the Media Lab, at MIT, where the study took place. They were told the study would last an average of half an hour, though they could use the system for a shorter or longer period if they felt like it. Users were encouraged to come with someone in order to guarantee having a collaborator. Parents and children, couples and friends made for the majority of relations. A total of 18 people participated on the study over a weekend period.

Photographs and notes were taken during the duration of the study. Comments and feedback were taken at the end of the study with some of the users sending reflections on the experience a few days after it had taken place.

For the study, we used brand new sketchbooks, with no marks on them.

Evaluation: *Introducing the NEDM*

Given one of the goals of the study was to obtain insight into the design parameters that were intuitive and inductive to collaboration, concentration and resourcefulness, little to no instruction was given on how the system worked. Users were briefly introduced to the platform, letting them explore it at leisure.

The creation stations were positioned front to front. Both users could see each other, but could not see what they were actively doing unless they went over to their collaborator's table.

The tables had brand new sketchbooks with no markings on them for each of the days the study lasted.

Twice Upon a Time was used as the preferred book for the study, but the sketchbook for Day of the Dead was left arbitrarily nearby.

Questions were answered when they arose, but there were no suggestions made as of how to better make use of the system.

Findings: *User Interaction*

Upon coming across the creation stations, most users were drawn to the familiarity of the sketchbook. At observing there was an image projected upon the paper, users wondered if it was actual paper the sketchbook was made out of. The most

natural reaction upon the discovery that it was a regular sketchbook, was to use a crayon or a marker to draw or write on it.

The projection of an image upon the open spread was intimidating to some. Unlike my predictions, not everyone felt inclined to flip the pages, but when they did, they were amused to see animation on them and sound coming from them. This was somewhat misleading, as at the time, the system did not support the making of animation nor of sound recording.

Users investigated the contents of the pockets of the table, associating what they saw in them with what was projected on the sketchbook. This gave them cues about the potentiality to use the materials with the sketchbook.

Users pressed buttons to discover their functionality; upon pressing the big red button, a projection appears with the image of a camera and a "SNAP!" text, making it clear to some that the button press means a picture is being taken.

Since I gave no indication of how the system worked, many couples would gather at one table only, failing to notice that they could each be at his/her own.

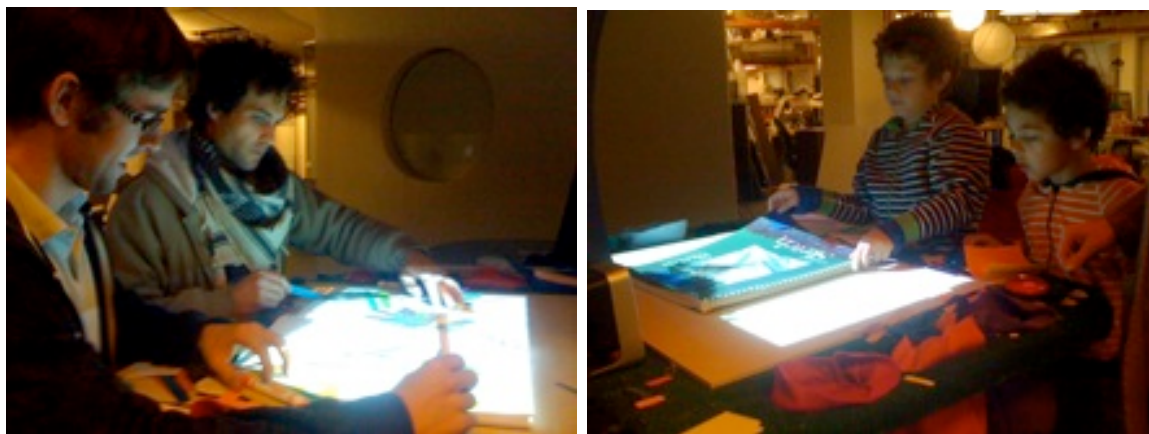


Fig. 21 Sharing spreads

Other couples were prompt at understanding each was to be at their own table, but not at realizing that the tables were networked.

Eventually, the collaborators that shared the same table would realize that both tables were identical, and that they could each work at his/her own.

The page number display, though projecting the page number of both collaborators on each table, did not seem to be enough of an indicator that the tables were networked. A user believed the number changed every time a picture was taken.

It was mostly by accident that users realized that they could collaborate, and though not detrimental to the system, it did provide some thought as to how to create a table that implied collaboration by design.

Users were curious as of how the system worked, children and adults alike were confused as of where the projection was coming from or if it was a projection at all. Upon discovery of the overhead camera, some of the users found it amusing to bring an object closer to it, playing with foreground and background.

Other unexpected discovery was that when they placed a three dimensional object on the table, there was some pre-conceived notion that the shadow of the object would not be captured. But when they saw it was, it prompted explorations with light, object position or making of the shadow an item of its own.

Transcript:

[Tomas]: "Wow! You can use the shadows!"

The fiducial markers seemed to be more intriguing than obtrusive. Upon understanding how they worked, some users tried to modify them to see if the image projected would change, or to design ones with the same parameters.

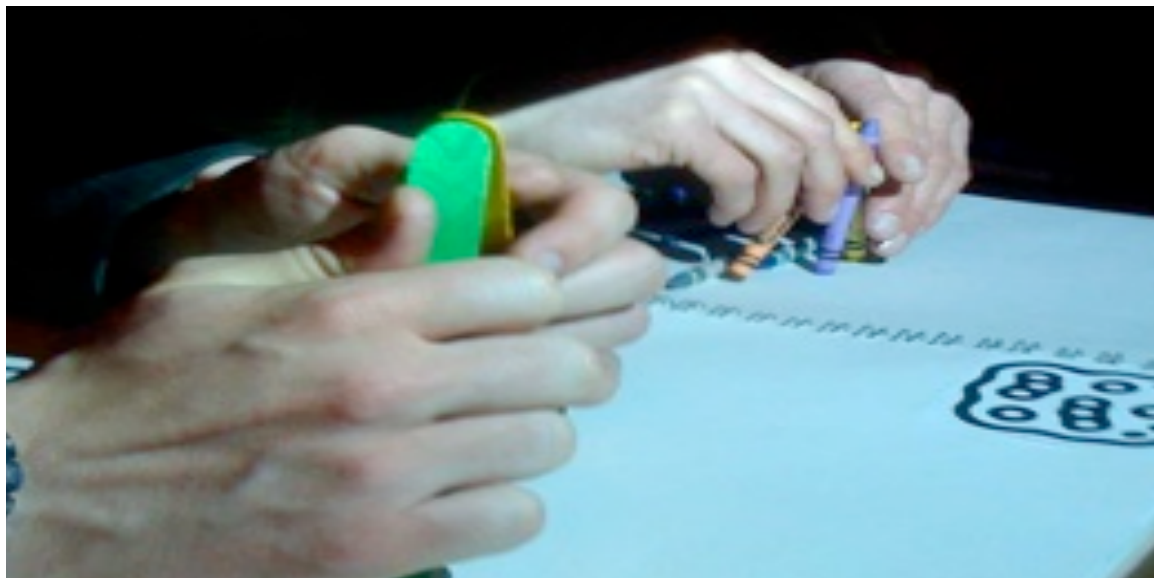


Fig. 22 Users “building” spreads and playing with shadows

This was an insightful observation towards making the design of Calliope’s fiducials human readable and potentially designable by the users themselves.

The vocabulary the users made use of to refer to what they were doing was of unexpected interest.

Most people talked about building and less about drawing.

When clearing a page by pressing the red button with nothing over the spread, a common word used was “erasing,” when my presupposition would have been “deleting” or “destroying,” since “building” was so frequently used. I want to believe this derives from working on a sketchbook.

Transcript:

[Maple]: “Let’s do a lot of stuff!”

[Jules]: “I’m going to build a blue rocket ship!” (uses blue candy)

[Maple]: “Oh cool!”

Findings: *Using Sketchbook for Scaffolding*

The sketchbooks created for Calliope had the function of hinting to the user the possibility of using any material desired for creation. The content of the sketchbooks was made with the same material provided in the pouches of the NEDM.

The sketchbooks contained still images, audio and animation in most of their pages, and thought they did not follow a linear narrative, elements would be repeated along the pages. Some of the pages were blank, with only audio embedded in them.

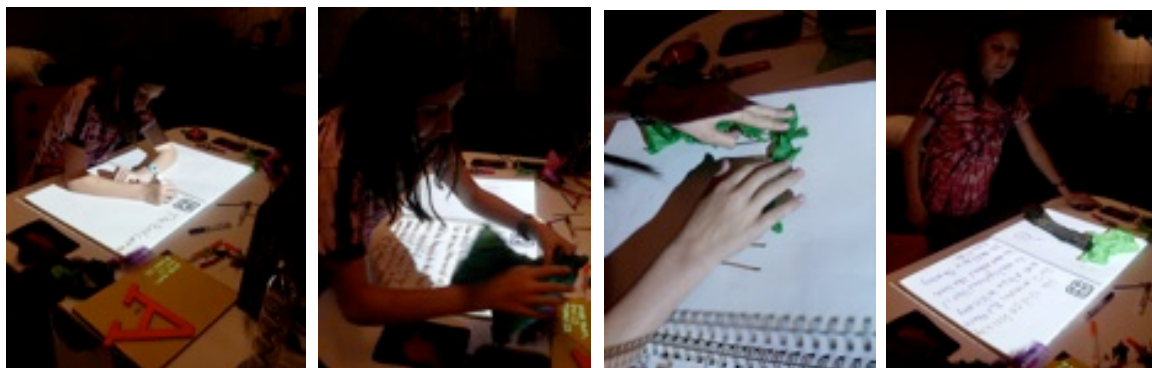


Fig. 23 Creating a linear narrative with collaged illustrations on the NEDM

The images on the sketchbook mainly produced two types of reactions. Some of the users were inhibited by them, while others actively sought to augment them with their own creations.

The animations seemed to be the most inhibiting, since the content moved across the spread and left little room for input. The narrative of the animation seemed to affect the interaction the uninhibited users had with them as well.

The simpler in character and action seemed to be easier to interact with, for example, the one depicting a bird that flies by and opens his beak seemed to be an easy and inviting one, while the ones made for the Day of the Dead book, which depicted two skeletons courting each other, seemed to be too complete of a narrative to invite any intervention.

Most of the users did not find any relationship between the pages, and thus not one linear narrative was created with it.

Some would fixate on one page and try to interact with whatever was depicted on it, while others actually used the sound provided for inspiration.

Transcript:

[Usher]: “Ouuu, this music is spooky! I’m going to make a candy monster!” “Wait, what happened to the music?!” (upon turning to a soundless page).

[Pedro]: “A page with sound! So cool!”

[Maple]: “Let’s make him an Indian!” (talking about the skeleton, and placing feathers on its head). “Look! Now he is looking at the bat!” “He will kill the bat!” (after placing a plastic bat on the opposite upper corner).

After getting acquainted with the system, most users wished for more blank pages to work on or for a clean sketchbook they could author. Sadly, we only had one ready which was put to good use by an 11 year old.

Being an avid writer and claiming not to be the best illustrator, she was excited to be able to write a story and have someone else illustrate it. While this is how the interaction started, when she realized she could use cutouts and sticks, she rapidly took over the illustration of her own story as well, making her collaborator a captive audience.

Transcript:

[Ursula]: “You could not just play with it, but write a real story and send it to an editor and have it edited and sent back to you. “It is really cool that you can put

anything...you can make an illustration of something, or even put that something or use materials to make that something.”

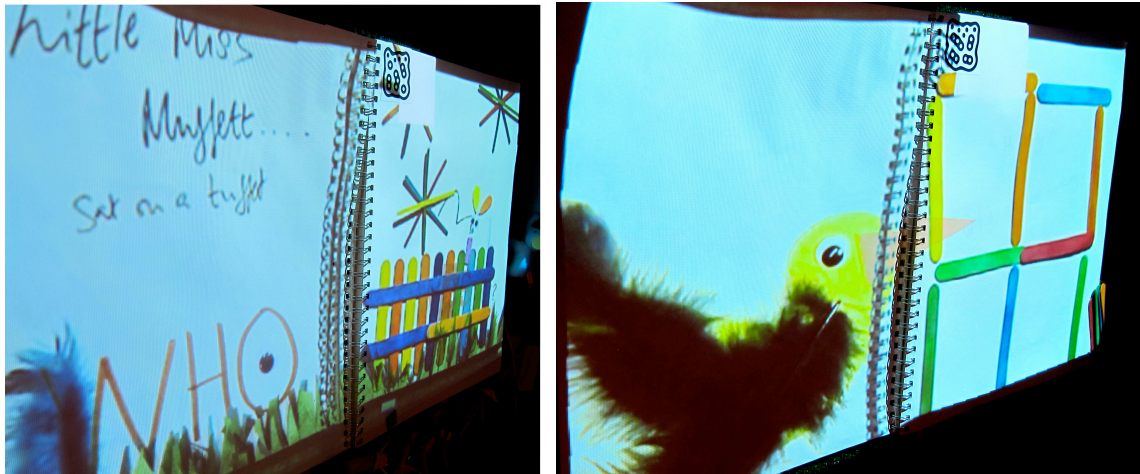


Fig. 24 A fence was made over pre-created grass, and a window for an animated bird

Findings: *Collaboration*

Users can choose to work collaboratively on a shared page spread or to work independently on their own. While some users found the immediacy of working together amusing, some preferred to work at their own pace on their own page and once satisfied with their creation, “publish” it and make it available to their collaborator.

This was an important observation, since one of the goals of the system was to give the option to work synchronously or asynchronously, allowing them to take their time.

There were occasions where asymmetry in the pace of working became annoying. While one user wanted to have a much more immediate collaboration, the other would want to take her time before sending something.

Transcript:

[Laura] “Look at my page, look at what I did!”

[Pedro] “Wait, I’m working!”

[Laura] “Come on, look, look!”

[Pedro] “I’m working, wait!”

The discovery of the tables being networked usually happened by accident. Users would be in the same page and they would realize that there were things “appearing” on their page. Two reactions were the most common: some would be annoyed at the fact that their creation had been disrupted, while some would find it amusing and would then on go on to interact in this way.

[Kelly]: “Oh wow! I got a message!”

Users who decided to work on the same page rarely flipped pages or moved on to make a narrative that made use of the affordance of the sketchbook to provide narrative structure.

If they created a narrative, they would do so on the same page by layering the evolution of it on the same spread, making it so that only the last “scene” was visible. While it made immediate sense, it also meant that there was no way of accessing the story again. This was a good indicator that making a system that recorded the history of every page and made it available in real time would make for a much more reflective system.

When working on separate tables but on the same spread, users had the need to communicate to each other verbally.



Fig. 25 Users met and co-create on the NEDM

Since writing on the page causes a permanent mark, one of the solutions implemented was to use sticks to create words or stamp body gestures that had an implicit message, such as “thumbs up!”.

There was also the need to receive feedback. Since there is a small lag on the system between sending and receiving, users wanted to receive confirmation that whatever they did had been received.

Transcript:

[Caitlin] “Let’s start on a new page?”

[Carolina] “I am building something!”

[Caitlin] “I made a nest!”

[Carolina] “I made a butterfly!” “Look, look! Can you see?”

[Caitlin] “Your butterfly needs eyes!”

...

[Caitlin] “Reminds me of an exquisite corpse but hands-on...”

Some collaborations seemed to have a better flow than others, with both users being actively engaged in one another’s work. Other collaborations seemed constrained and polite, with the collaborators seemingly fearful of judgement or appearing insulting.

Findings: Making Up Games

One surprising aspect found during the study was to see collaborators inventing games that exploited the attributes as well as the shortcomings they found in the system.

One of the participants found it annoying not knowing where in the page her friend was working on, thus their creations would often overlap.

At the sight of the problem, her friend shouted:

Transcript:

[Katheleen]: “Battleship!” “Let’s play Battleship!”

A couple of younger users decided to play a game that implied gathering an object at a time from somewhere away from the table and trying to cover the blank page one object at a time. The ultimate goal was to be the last one to place an object on the last blank bit left.



Fig. 26 Spread covered up as part of a game where the one to fill the last blank bit wins!

Findings: *Using Your Body*

Taking pictures from hands and faces became one of the favorite activities for many of the users, as it was usually discovered by accident and provided an unexpected surprise:

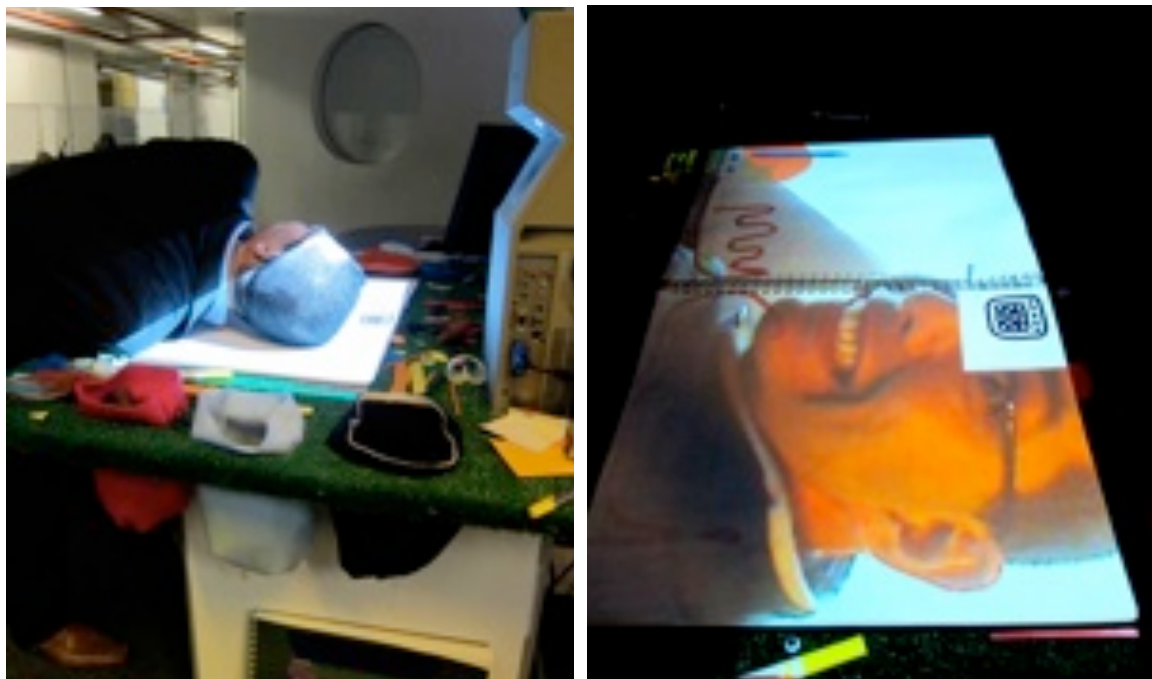


Fig. 27 User “stamps” his face

Transcript:

[Usher] “Wow... what the heck... that’s MY hand!”

[Desmond] “Wow!”

[Usher] “Put your hand!” “Wait, put both your hands and I’ll take a picture!”

[Desmond] “No, lets both put our hands!”

[Usher] “Can we put our faces?!”

[Pedro] “Look, look at what I sent you on page 10!”

[Laura] “Ja! (upon looking at his face) Let’s kiss!”

[Pedro] “Ok!”

Being able to see one self almost instantly, to sketch over one’s body parts was very exciting. It seemed to provide a means of communicating emotion and authorship not found in the materials per se. People drew on each other’s faces, sent each other “thumb’s up!” messages, or just were happy to “sign” with a hand.

Findings: *Using the Surroundings as Material for Creation*

The NeverEnding Drawing Machine is designed to allow the users to turn the content of their surroundings into creative material by perceiving them for their sensorial attributes.

We attempted to hint at the ability to do so by creating content for the sketchbooks that included elements that were visible and within reach.

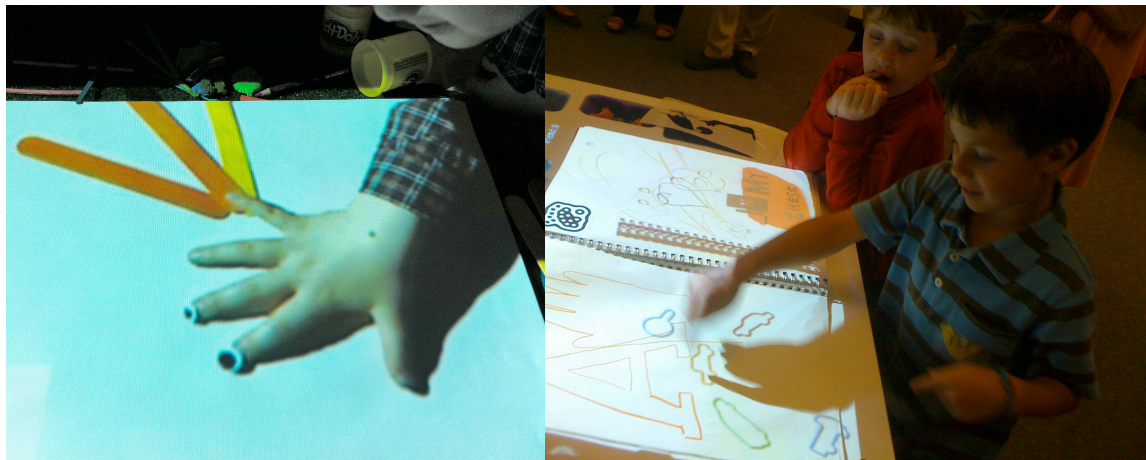


Fig. 28 Children adding googly eyes to their finger tips and using their SillyBandz®

While it was not that obvious for many, perhaps because the paper interface became misleading as only permitting mark making; the capacity to use objects was nonetheless eventually understood and made use of.

Most of the users limited themselves to use what was available on the table, and not all explored their surroundings in search for materials that better suited their vision. This might have been a consequence of holding the evaluation at the Media Lab, which might have intimidated the users to go wander at will. This conclusion stems from the fact that most users did use their body as creative material.

A few users would use personal objects they carried with them, such as wallets, watches, jewelry and mobile phones. An 11 year old girl made use of her tie-dye t-shirt as the sunset sky for her landscape.

Although perhaps not exploring the environment as much as hoped for, users did use the material at hand and gave it many different representations. It seems that if the NEDM had been in a different context were users felt more comfortable with their environment they would have been more inductive to go exploring or bringing in personal objects.

Transcript:

[Usher]: 'I love it! It is fun to play with! You can put anything you want!'

[Desmond]: 'Yeah! If I had one of this I would put a cat on it! I would put everything! My whole kitchen! Everything!'

[Usher]: 'Yeah! I would put all the stuff in the bathroom! I would put the whole house! Yeah, I would put the cat too!'

[Desmond]: 'Yeah! I would put the whole house!'

Findings: *Focused Attention*

Users seemed to enjoy their time at the NeverEnding Drawing Machine. Whether collaborating synchronously or asynchronously, users spent the 30 minutes the study lasted as a minimum.

Users that decided to work asynchronously would spend more time on their own page, actively trying to create a meaningful and complete piece rather than have the immediacy of synchronous collaboration.

Transcript:

[Sofia] (to Tomas): "Wait! I don't want to leave, I want to finish a story!"

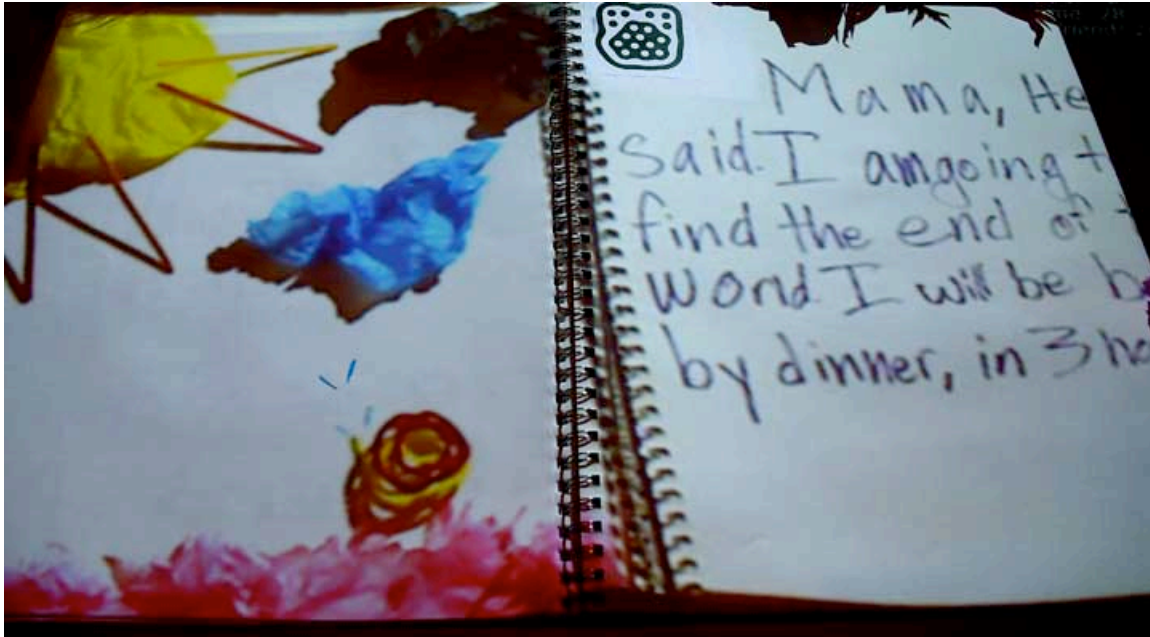


Fig. 29 Illustrated finished story!

3.2.8 Informal Study

During the celebration of the 150th Anniversary of MIT, we held an Institution wide Open House. The Media Lab attracted a large public, many of which were able to make use of the NeverEnding Drawing Machine.

Unlike the formal study, people were not called or compensated in any way. They came curious to know what the NEDM did. Given the amount of people wanting to make use of it at once, it was very difficult to have a controlled, quantitative assessment, but for this very same reasons, the insight obtained from such interaction was very much the richer in shedding insight on how the system would operate once left “out in the wild.” Parents and children, professors, teenagers, couples, people representing a wide spectrum of society gathered around the NEDM to either witness other’s at play, or to play with it themselves.

Little to no instruction was given, preferring word of mouth or learning through observation. It was delightful to see people who had never met before teach each other the functionalities of the machine, and share tips and discoveries with each other.

In the few moments where the crowd dispersed, I had the fortune to study a kid that must not have been over 5 years old take his time at analyzing not only how the system worked, but try out different things that he could do with it, like using

three dimensional objects, placing them far and close from the camera, and using the shadow of the object as a shape he could then draw on.

Stamping hands and using body parts became one of the biggest attractions, drawing people to not only collaborate from table to table, but to gather around one table and create a “collage of body parts” to send to the other.

Elder and children shared moments and pages with no need of introduction.

Given the amount of people wanting to make use of it, it was hard to say how long each participant would have continued using it if possible. But it hinted that the engagement would have been sustained for long enough time to complete a thought.

The NeverEnding Drawing Machine as a Research Platform

Three investigators, out of which one is in the Autism Spectrum Disorder, have been working closely together, researching how changing the parameters of their means of communication affects the kind of communication they have.

Video is one of the preferred mediums of the investigator in the Autism Spectrum, having a selection of favorite ones that have been watched thousands of times. This have been changed in speed and played backwards, with scenes printed in paper for tangible manipulation and because paper also has a special attraction.

This three investigators made use of the NeverEnding Machine as a tool for their research. The NEDM gave them the freedom to project their own material and to change its display form being vertical to horizontal.

It also allowed the video to change tangibly, as every time the page was flipped, the video changed. It was left to further investigation to see how did mixing both mediums, paper and video into one by projecting video into paper affected the relationship had with each of them.

Augmenting the video with physical objects, specially body parts, was of special interest, as it would mean one became part of the narrative. Sadly, the NEDM was not networked, so there was no collaboration between stations. Nonetheless, there was interest in knowing altering the video “from afar” by the collaborator would affect the perception and sense of control of the viewer.

More investigation on the matter is due with Calliope!

3.2.9 From the NEDM to Calliope

The Never Ending Drawing Machine served as a great training ground from where to start designing Calliope, both in form and function.

From the start, Calliope was envisioned to be adaptable to any setting; to be portable and easy to use. The NEDM, because of its size and design is more of a stationary project, where people can congregate at one place to collaborate.

Calliope is meant to have a more personal character, to be a toolbox for the creative nomad with the potential of transforming the space is at into a sharing ground.

From the NEDM we learned what was it that users wanted to make out of it; what size and form factor served best for in-situ collaboration as well as how asynchronous transfer of media affected the way the artwork was made.

There are a few crucial differences between the NeverEnding Drawing Machine and Calliope.

The NEDM, because of its size and hardware design is a platform where people congregate to collaborate. It is hard to transport given its calibration issues and hard to replicate given its cost. The software, as well as the distance from the camera to the sketchbook are specifically designed to meet the hardware limits. The NEDM does not offer much flexibility or opportunity to add features to the mode of creation.

When using the NEDM, in order to make any changes to the sketchbook, whether it be what kind of content it will display, or the history of the iterations made to it, the user has to be knowledgeable enough about the software architecture and interact directly with the computer. There is no way of accessing the story of each page unless one accesses the file system where the images get stored. Thus, the NEDM does not offer any immediate access to the documenting of the creative process.

Moreover, the NEDM only displays the last two layers created. While this makes sense when interacting in a synchronous manner with someone, it offers no way of further elaborating a spread or “going back.”

The fiducial markers of the NEDM are not human readable. Calliope's fiducial markers are designed to be not only human readable, but to convey a message. They are designed as dominoes that while telling the computer what image to project, they also tell the user what page number they are on.

The NEDM integrates TouchDesigner, the software used to build the patch, with ReactIVision, the software used to read the markers, thus needing two cameras: one to read the fiducial and one that serves as live input. Calliope is all written in OpenFrameworks, and makes use of its OFx fiducial finder library to read the custom designed markers. This way, it only makes use of one camera for both functions.

When interacting with the NEDM, it often happened that the users would make a spread that involved the use of both hands, leaving them at odds as of how to press the button. Calliope substituted the button with a pedal, giving full freedom to both hands.

The NEDM was configured to fit a specific sized sketchbook, the only way of changing this is by making changes to the software architecture. Calliope takes advantage of the use of fiducial markers, making the homography and auto-pinning of the projection to the sketchbook automatic.

This way, any sketchbook can be used, with the calibration being done automatically just by placing the corner fiducials on the sketchbook corners.

While the NEDM was designed as an integrated “creation-station” with all of its parts being co-related to each other, Calliope is designed to transform any surface and any sketchbook into a “creation station.”

Finally, Calliope’s cost is much lower than that of the NEDM, facilitating the creation of more “creation-stations” to network.

3.3 CALLIOPE

A PORTABLE TOOL FOR COLLABORATIVE VISUAL THINKING

Calliope was created as the evolution of the NeverEnding Drawing Machine in the search for creating a portable system that could travel beyond the boundaries of a laboratory setting or of any setting, by being compact and adaptable to any table, any surface, anywhere. Calliope is designed for the transient and nomadic as well as for the stable, but it pretends, through its design to be taken out into the world, and be a personal tool, not a fixed station.

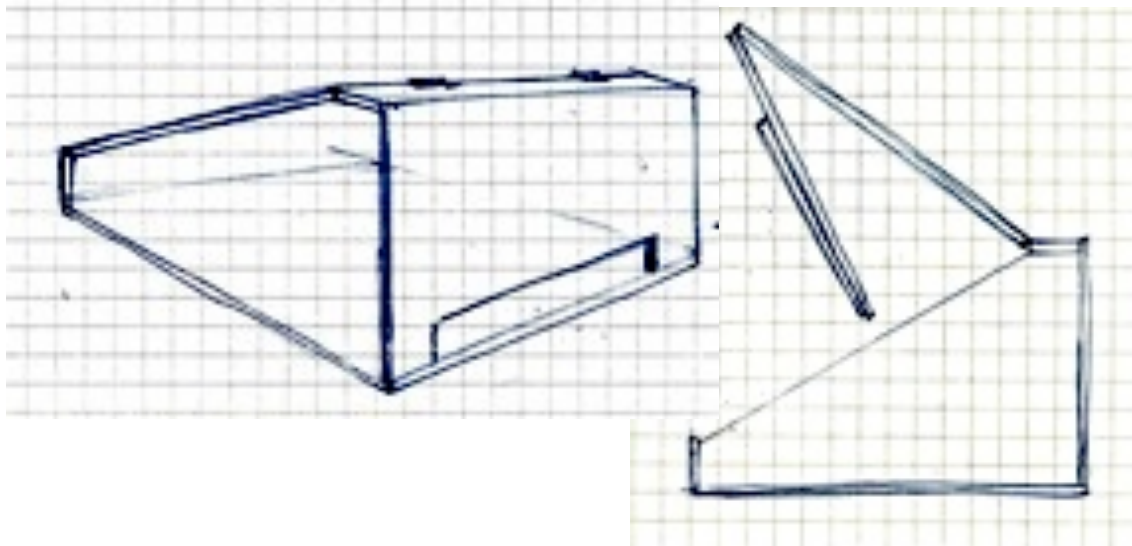


Fig. 30 Sketches for Calliope's hardware design

3.3.1 System Overview

Calliope, is a portable stage for collaborative, cross-cultural, cross-generational storytelling. It was designed as the evolution of the NeverEnding Drawing Machine after looking at the potential and the limitations it presented.

Calliope, like its predecessor integrates paper and a computing platform to emphasize the social experience of sharing object-based media with others. It aims at engaging the user in a reflective aesthetic experience.

Like the NEDM, it incorporates analog and digital techniques as well as bi-directional capture and send of media, offering co-creation among peers whose

expertise may not necessarily be in the same medium. It also offers the possibility of integrating objects as objects, as characters or as background. Objects bring vibrance to a story; the story brings out the significance of the objects. It also uses a paper sketchbook as the primary interface, making Calliope an inviting platform by simplifying the interaction through the affordance of the sketchbook.

Creating a story on Calliope does not require the user to learn a new environment, on the contrary it is aimed at supporting the user's creative endeavor by allowing her to use whatever expertise in whatever medium she previously has and augment it.

Calliope, like the NEDM, is a scalable platform composed of two or more networked "creation stations" allowing synchronous or asynchronous collaboration across distance.

Using Calliope is an exploratory endeavor. There is no right or wrong way to use it, as the interface presents no learning curve. Calliope thus is more of an expressive tool, by which we can create and share linear or abstract narratives by using whatever media we feel suits us the best.

3.3.2 Scenarios

Cross-generational

The grandmother of a five year old child misses her grandson. Her daughter has been relocated to work in China from their native Brazil and grandmother and grandson rarely get the chance to visit each other. Online conversations are the only means they have to communicate. The grandson can barely focus on the conversation, preferring instead to go back to his games. The grandmother feels ever more distant, as she sees the interaction they have is limited, and the cultural and generational gaps keep growing larger. While she does not relate to Chinese culture, her grandson is acquiring it in his day to day. She would like to play with him, with his toys, to understand his reality. She would also like him not to lose his Brazilian heritage, and to share with him her keepsakes and their meaning. She wishes there was a way to introduce herself into his landscape without being intrusive but more of a presence. The grandmother's home as well as the grandson's are equipped with Calliope. On it, the grandmother can "stamp" the objects she cherishes the most and write a story about them for her grandson who in turn can elaborate on them, embedding them with his own understanding. What was a limited interaction, subjected to time-zones and scheduled appointments, became a much more organic interaction, with grandma being able to leave little "gifts" for her grandson to stumble upon and in return receiving a much more intimate way of engaging.

Cross-cultural

A rural school in Uganda is outfitted with Calliope. Their "creation-station" is networked with one in a school in Japan. The teachers in Japan see the beautiful fabrics with colorful patterns the women in Uganda wear. Both cultures realize their love for patterned fabric. The Japanese teachers expose the Ugandan to kimonos and design an illustrative book with beautiful depictions of the techniques of Furoshiki, the traditional Japanese method of wrapping with fabric. Ugandan teachers pass on the acquired knowledge to their students. Furoshiki is adopted in Uganda and quickly spreads to Rwanda, Kenya and Tanzania, where plastic bags have been banned. Calliope becomes a platform for sharing commonalities between cultures as well as difference appreciation. It allows re-contextualization and a new sense of value for what we might take for granted.

Debunking Myths of Creative Handicap

An eleven year old girl has already been made to believe that she does not know how to draw. She feels much better suited to writing stories than to illustrating them, though in her mind, she knows what the story looks like and feels frustrated at believing she cannot make her vision come through. Her neighborhood Computer Club House has Calliope, which she uses to write a story. Given that she can use objects, and "stamp" them, she realizes she does not necessarily has to draw her story, but can use anything to illustrate it. The girl goes about her surroundings, looking at everything for its sensorial qualities and not for its obvious functionality. She uses leaves to represent canoes, and her pink and purple tie-dye T-shirt serves as backdrop for her sunset landscape. Liking what she sees, she shares her story and begins collaborating with a girl from a different country, illustrating and co-writing stories and learning about each other's cultures, not only by exchanging visual artifacts, but by reinterpreting how they are used.

3.3.3 Design Considerations

Calliope was designed to be easy to replicate, light to travel with, affordable and intuitive. Our first design was to be an adjustable arm that could fit the thickness of any table. Since we wanted the system to be able to be used on any surface, this design immediately proved problematic.

The next design was to be a box that contained all the electronics and an expandable arm that would hold the pico projector. Although feasible, the arm had to be quite high for it to cover the area of a large sketchbook, making the projection very dim and thus needing a very dark environment. At that height, the stability of the arm was not very reliable either.

The idea of the box was in accord to our intention of evoking of a suitcase theatre. Our challenge was in how to shorten the distance from the projector to the sketchbook.

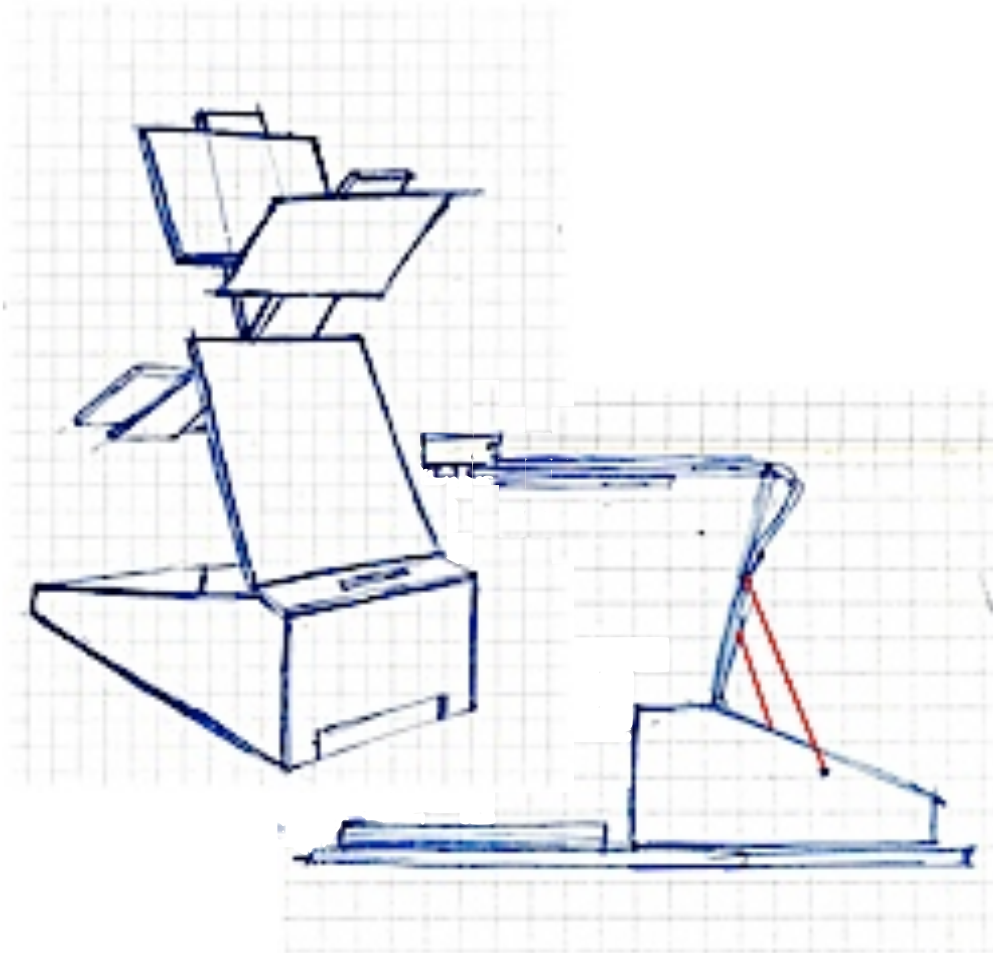


Fig. 31 Calliope's final design with flip mirror and attached overhead camera

The solution implied using a mirror where the projector would bounce off from, and project back down to the sketchbook, and while still needing some height from the projector to the mirror, this was considerably shorter. This meant we had to embed the projector within the box, and that the height of the box would be largely determined by that.

We measured the distance that would be needed to cover the largest size sketchbook available, and designed the box to achieve that height. Our way of gaining some inches implied making the lid of the box a slant, thus having a lid longer than the bottom.

Magnetically attached to the lid there is a mirror that folds out and over it, of the required size and distance to cover a large sketchbook
Straps attached to the lid and to the sides of the box, serve to hold and adjust the angle of the lid.

The straps are made of leather, and provide enough friction to hold in place without the need of pegs or holes.

The overall size of the box was mostly determined by the throw needed from the projector to the mirror and from the mirror to the sketchbook.

We embedded the projector in the box, shooting up at the mirror and bouncing back to the sketchbook.



Fig. 32 Prototyping Calliope

HARDWARE

The design of the box was inspired by Constructivism, a Russian post revolutionary artistic movement whose principal theory was that art should serve the social

purpose and was characterized by an acceptance of technology and everything modern.

We wanted the physical design of the box to reflect the merging of analog and digital media. While the technology is not hidden, it is also not over emphasized.

At first sight, Calliope is a wooden box with some of its surfaces painted with magnetic and chalkboard paint.

Upon opening the box, one discovers the system and its components:

- ▶ a small computer (Mac Mini)
- ▶ a pico projector (Micorvision Showwx)
- ▶ a micro-controller (Arduino)
- ▶ a foot switch (Conntrol 862)
- ▶ a HD webcam with microphone integrated (Logitech C905)
- ▶ a speaker (Edifier USB Soundbar)



Fig. 33 Final Calliope, front and back views

The interior of the box has two layers and a front compartment. The bottom layer conceals the computer, speaker (though it is visible from the front of the box) and micro controller. The front compartment encloses the pico projector.

To minimize any possible calibration errors, the camera is enclosed in a small box that attaches with magnets to the lid when flipped open. This also places it right over the sketchbook, where it can both read the fiducial marker's value and capture the image created on the spread.



Fig. 34 Projector reflecting off mirror and onto sketchbook

The front compartment conceals the pico projector which is press fit at the exact position where it can project straight to the lid's mirror that bounces back the image onto the sketchbook.

We considered various projectors, but settled on a laser pico projector mostly because of its compact size and its infinite focus. These features make it so that there is little to no need to access it or make any adjustments. One simply has to power it, simplifying the system to a plug and play device.

Although the brightness was very similar to that of LED pico projectors, these ones have the advantage of not having the speckle the laser ones do.

The foot switch serves the same capture purpose that the big red button did for the NEDM. The decision to use a pedal instead of a button emerged when observing that users would engage both hands, having none free to actually capture the picture at ease and resorting to the elbow.

The upper layer of the box stores the foot switch and attachable camera, the rest of the space is intended for the user to be able to store whatever material or objects she wants to make use of.

The surfaces that were painted with a layer magnetic paint covered with chalkboard paint. This way the box is a canvas that can be personalized and where the magnetic fiducial magnets can be attached and handy.

SOFTWARE

The current system is coded in openFrameworks. openFrameworks is a C++ library that offers a more intuitive framework for experimentation.

There are three stages of the system: getting inputs and extracting information, media storage and alternating internal states and output generation.

We use Dropbox for data sharing between users. The update usually takes less than 4 seconds. Accessing the collaborator's data is the same as accessing any file in the collaborators file system.

Inputs

There are three input sources: camera, microphone and pedal.

Camera inputs: fiducial Tags



Fig. 35 Calliope's action tags: layering, sound recording and page history

We decided to use fiducial markers to communicate with the system and to costume design these to be human readable. The ofxFiducialFinder toolkit is being used to detect the fiducial tags.

There are three types of fiducial tags used in our system: action tags, page tags and corner tags.

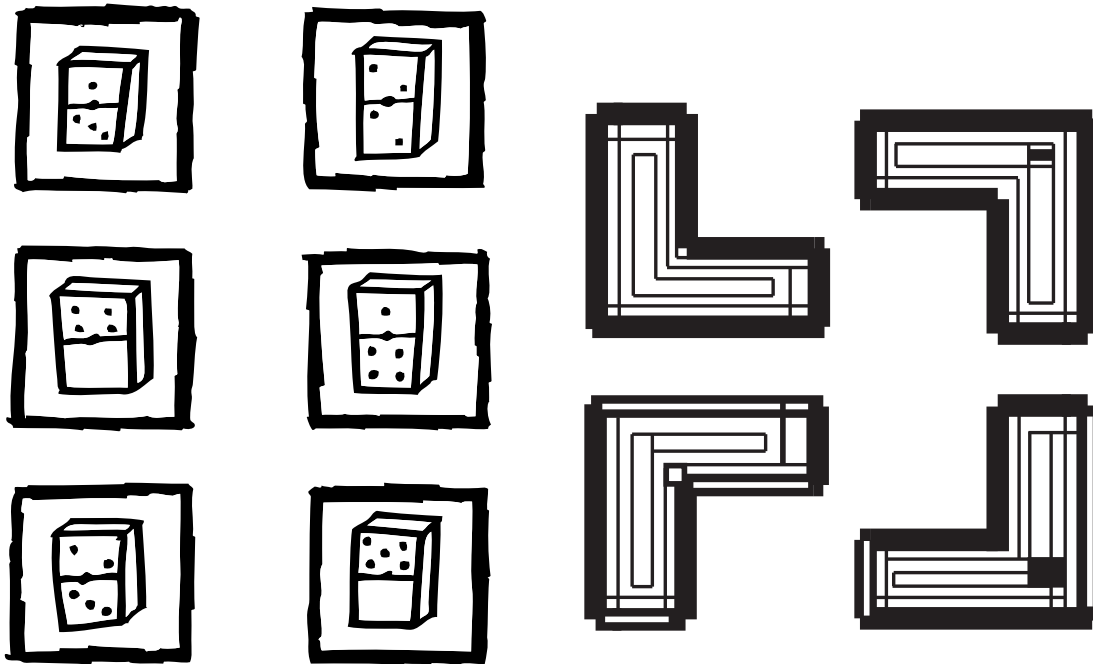


Fig. 36 Calliope's page and corner tags

Action tags play, record, change the display of layers or show the history of the page.

Page tags associate the content to be projected to the page number, this way the sketchbooks can be synchronized.

Corner tags are used to auto-pin the projection to the sketchbook

Each fiducial tag corresponds to a digital string which explains its topology. We store these digital strings in an XML file. The ofxFiducialFinder reads the XML file, and imports them into an array. If something from the camera input is recognized by ofxFiducialFinder, the index of the tag's digital string will be exported. The system categorizes these indexes into pages, actions, or corners. The system then change its internal state based on the inputs. The internal state functions as a switch.

It decides which input sources and media files will be fed into the system and get processed. It also decides what the output will be.

It is composed of three major parts: action states, user states and display states.

Action and display states are user specific, they exist only in memory and are not shared nor stored. They are also determined by the action of the user. User states configurations, on the other hand, are shared between users. These decide what media file, snapshot and audio streams should be fetched. The User states are displayed on the status bar of the sketchbook.

Display mode decides whether to display the last two snapshots or all of them. It is set to display the last two by default unless the layering fiducial is used.

3.3.4 Future Work

Calliope's collaborative system is looking to launch a website where users can upload, synchronize and share digital content with other systems. The website is already under way.

We hope to place Calliope in different locations that are conducive to collaboration across cultures and between different generations and see what kind of work and through which means is created then.

We would like to examine how does having access to the creative process by giving immediate access to the history of every page affects the mode of creation.

Section 4

Conclusions

4.1 CONCLUSIONS

In this document, I presented Pillow-Talk, the NeverEnding Drawing Machine and Calliope as tools for Creative Thinking.

In the introduction I talked about the recent call made for creative thinking as a valuable asset, but the little attention paid to providing the time and space needed for adaptation and self-reflection, both crucial components of creative thought.

I continued by trying to provide a theoretical framework on the importance of creative apperception and a flexible mind for psychological well being.

Using the “distorted mirror” metaphor, I spoke about self-reflection through societal mirrors: co-creation, collaboration and objects as containers of thought, and through personal ones, taking the dream as a daily creative enterprise common to all, demystifying creativity as exclusive.

Pillow-Talk was then introduced as a tool to promote a flexible mind that is able to endorse and hone the benefits presented at every level of thought, taking the visual imagery of dream and its rule-free landscape as a place where to test and try old and new knowledge at will.

An informal user study noted the problems of the design, as well as proposing further uses of Pillow-Talk, with applications as varied as Image Reversal Therapy. It was interesting to see that just having the pillow served as a primer for recall. It being perceived as a companion and not only as an object to record upon, touched on the potential of the seamless integration of technology into our intimate objects.

The NeverEnding Drawing Machine and Calliope were then presented as tools to promote flexibility in vehicles of thought, both through offering the freedom to use anything as material for creation and by being tools for cross-cultural, cross-generational co-creation. A user study revealed the power of visual imagery for communication, and how recasting our environment into a different medium refreshes our perception of it. With collaboration happening between strangers of all ages and cultural backgrounds spontaneously, it was shown that having an almost inexistent learning curve in the system as well as making use of the affordance of a sketchbook was conducive to fluid interaction and sustained engagement.

We are currently working on deploying Calliope and doing a user study on it's performance. We are curious to see what kind of stories will be created, with what kind of materials and how will context be translated.

We are currently working on a website where users will be able to upload “digital sketchbooks” to be shared, projected and augmented by analog means in whichever networked “creation-stations” choose to do so.

4.2 SUPPLEMENTAL MATERIAL

Media including Interviews to users of Pillow-Talk and the NEDM can be found here:

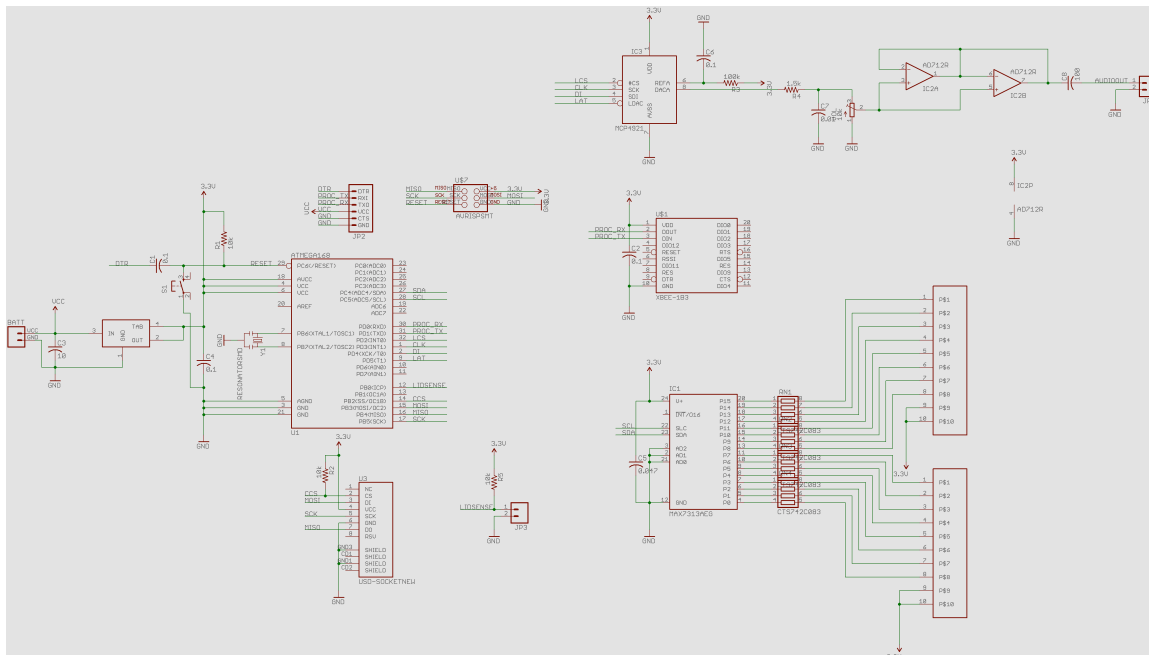
www.vimeo.com/edwina

The NeverEnding Drawing Machine:

nedm.media.mit.edu

Calliope:

calliope.media.mit.edu



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