



experiential **PROTOTYPiNG**
A NEW APPROACH TO THE DESIGN PROCESS



Experiential Prototyping:
A New Approach to the Design Process for Complex Systems

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THE NEED FOR A NEW DESIGN METHOD: Experiential Prototyping

Our world is becoming increasingly prevalent with technology. In the future, mobile communications and networked objects and spaces will be ubiquitously embedded into our environments and products. In fact, it is already happening today with increasingly sophisticated cell phones that allow for entertainment services such as mobile TV, GPS, and photo-enabled “tag and scanning” and payment services (International Telecommunications Union, 2005). Additionally, the technology is spilling over into new tangible forms such as wearables (interactive clothing), interactive retail and a plethora of blue-tooth enabled devices that we wear, carry, or use in our environment. This world, according to science-fiction writer and visionary Bruce Sterling (2005), is called the “internet of things” in which computer technology interleaves with the world of material objects and re-defines the relationships between people, our tools, and our possessions (worldchanging.com).



Figure 1: Technology Integrated into our Material World

Given this increasing prevalence of embedded ubiquitous technology and the factors shaping the future of material objects, the impact for designers is significant. It means developing a new design practice that moves beyond designing media and interaction for just another handheld device with a screen on it, toward designing for alternative systems of objects that interact not only with people, but also with other objects and their environments. “Protocrat” is the term Sterling (2005) coins for the creative, community-minded individuals who will participate in the realization of these new design solutions: a group of inventors, venture capitalists, journalists, and designers. He uses the phrase, “the actual is the new virtual” to describe one of the ways that design will become the norm as far as solutions to the big problems of the future (B. Sterling, personal communication, September 12, 2005).

Further impacting designers is the concept of the internet not only spilling into material objects, but also of our objects and environments becoming smarter and

seamlessly networked. In *The New Ecology of Things*, core faculty of the graduate Media Design Program at Art Center College of Design, Philip Van Allen (2005) describes this new impact. "With massive RFID tagging and the deployment of smart networked sensors and wireless personal information devices, a new ecology of things is developing. How will people and things interact in this fluid environment of tangible artifacts and the data-spheres that surround them? Who will determine how this interaction works?" (p.1) Most importantly, how do we design for these systems? Gone are the days of the lone designer. This emerging technological infrastructure requires a more sophisticated approach to design that understands social interactions, networking, integrated systems and communication, and examines potential experiences within a social context.

Hence, Van Allen's New Ecology of Things is becoming the *New Ecology of Systems*. An example of a current system is Apple's iPod music system. Not only does it include a device (the iPod), but it also includes software (iTunes), services, content and an entire technological infrastructure. But the iPod still needs to be manually connected to a computer to exchange any data. Building on Van Allen's notion of the New Ecology of Things, what happens when the iPod is networked to other iPods and the environment in which it is nested? This adds yet another layer of complexity to the system and evolves the New Ecology of Things into the *New Ecology of Systems*.

Research Questions

What does this new ecology of systems mean to designers? Edward Bevan, Vice President of Communications at IBM Research, asked the question during his visit to Art Center in November 2005, "How do we visualize our information, interactions, and our experiences," and design for ecologies of systems that are increasingly complex? This is a challenge for designers. Nikolaus Hafermaas, chair of graphic Design at Art Center College of Design and owner of Triad located in Berlin wrote in a syllabus for a new class sponsored by Sun Microsystems in September 2005 that focused on design solutions for emerging technologies: "We are dealing with a subject that is technologically highly complex, yet it will have a revolutionary impact on how we will interact in the near future with objects, services, our built environment and with each other. We will make the attempt to match a new technology with needs, uses and applications that have yet to be defined. Translating

our thoughts into convincing and tangible scenarios will be a main design challenge” (Hafermaas, 2005). As the *New Ecology of Systems* become increasingly more complex with an infinite number of variables, how do we design these systems toward successful solutions? More specifically, what role does media design play when designing for emerging technology and new ecologies of systems? How can this role be applied to the design process as a new method for system designers? This thesis explores these questions and this exploration in turn results in a new design practice that encourages collaboration and guides design teams in the ideation, evaluation, and communication phases of the design process called *Experiential Prototyping*.

THE NEED FOR A NEW DESIGN METHOD: Examining the Design Process, Narrative and Working Models

Our experiences are increasingly digital and connected. The complexity of interactions in our new world of the ecology of systems is exponential. There is now an infinite amount of variables to work with. My foray into this began with a project developed in response to the emerging technological infrastructure of the *new ecology of systems* and the seemingly endless possibilities within them. Designing for these ecologies is a much different way of problem solving than the way designers are normally trained. These complex systems consist of devices, software, databases, interfaces and an array of interactions based on social patterns and people's behaviors, turning the way we approach design into a delicate balance of experience, interaction, and form. Designing for these systems requires a more sophisticated approach to design that includes social interactions, networking, integrated systems, communication, and potential experiences within a social context simultaneously. In response, I wrote a (mini)festo arguing that the *new ecology of systems* requires a change in the way we think. *Flat to Fat* takes the form of a book. As it is read, interaction with the book turns the flat pages into three-dimensional form. Much like the added dimensionality of layered thinking that these new ecologies have inspired, the flat book folds into a flower making it a communication technique that combines narrative with interaction and suggests new ways of thinking through the transition of flat to three-dimensional form. This formbook was the first manifestation of how to approach thinking about designing for a new ecology of systems.



Figure 2: Form Book

The complexity of these new systems involves many disciplines in the design process such as engineers, sociologists, ethnographic researchers, and experience designers to name a few. So, how does everyone see and work toward the same vision and define design parameters with an infinite amount of possibilities?

To begin to answer this question, I met with industrial designers (August 2005) working in a footwear design company. They were in the middle of prototyping a new top-secret training system that involved an intelligent shoe, a wrist-band, and other devices. We walked down to the model shop where they had assigned three people to sand and refine hard models of each device. While looking at the hard models, I couldn't help but wonder what the experience of the system as a whole would be. Prior to spending the resources to design and develop hard models, the prototype could benefit from an evaluation of the experience since each device would live in a system ecology. But how does one begin to analyze an experience?

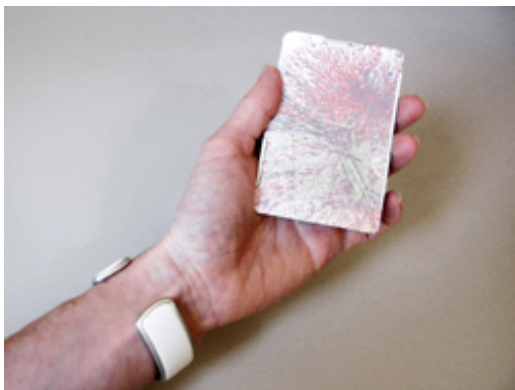


Figure 3: An Example of a Hard Model—Personal Communication Device and Networked Wrist Band with Flexible Display.

The answer began to emerge when, in September-December of 2005, I participated in a class Sponsored by Sun Microsystems. Sun previewed the class with new technology developed over the last year called SunSpots. Sun Microsystems requested that the class invent uses, situations, interactions, and systems based on their emergent technology. SunSpots expanded the concept of computing directly into our material world. They are wireless, can be networked, fit in the palm of your hand, and include a kitchen sink of sensors that can help support visions of new interactions within our physical world.



Figure 4: SunSpots

The most effective approach that the designers in the class used were the ones that wrote stories, visualized them, and acted them out in an immersive and experiential way. Designers used SunSpots to successfully simulate the potential interactions within the system through the combination of the working models and stories. The stories help ground the interactions in the larger context of the system in which they were embedded. The demonstrations were extremely effective by being fast and inexpensive. They generated dialogue among the team to improve the concept. This put the emphasis on the experience, social patterns, and needs of the users rather than on the technology itself. It created a dialogue and inspired other ideas within the context of the story that led to potentially deeper and more meaningful interactions within the architecture of the system.

SunSpots' emergent technology highlighted the potential value of story informing design in the new ecology of systems. This examination made me question whether the approach of combining stories with working models could have benefited the training system that the footwear company was designing. Had they first developed working models to test the viability of the interactions and merged it with a story based on the social context to test the interactions and features within the system, would this result in a better design solution and overall system?

This leads to adding two factors to the design approach: 1) developing social context through the use of narrative, and 2) examining interactive experiences through the use of working models. "Narrative meaning is about connections. It links individual human actions and events into inter-related aspects of an understandable composite. Narrative displays the significance that events have for one another,"(stevedenning.com). Uncovering the uniqueness of the story of people's lives and how the story can interact with the technology that is all around them results in a social way of innovating technology through the use of narrative. Combining the narrative with working models brings the stories to life, making it a new way to participate in the design process toward a better understanding of complex systems and toward innovative, collaborative solutions. This method expands storytelling design solutions with a basic understanding of electronics, sensors, and programming integrated into these new design systems. The result is a much richer and useful experience of a prototype geared toward the interactions of real people. The method allows for the experiences of interactions and features within the system's ecology, which inspire design and form for products and services at a later stage. This new approach to design is called **Experiential Prototyping**.

The method of Experiential Prototyping for interactive systems can be compared similarly to the way "concept cars" are used in the process for transportation design. To compare the design process to that of another discipline, I met with Rich Overcash, a transportation designer who described the notion of the "concept car" as a method for the transportation design process that inspires design for a later stage, but that communicates an overall understanding of the entire experience. The concept car is a "blue sky" combination of form, function, and overall experience that you can hop into, drive, interact with the dashboard, and get a sense of the overall experience. The form is a result of research into the desires of

the people and their context that the device is designed for. The use of the concept car in the transportation design process is similar in concept to Experiential Prototyping for complex systems where it becomes a tool that translates research into a design solution that provides an experience of the overall system to inspire design at a later stage. However, concept cars are very expensive to make. Experiential Prototyping fits in the design process similarly, however, the method opposes the expense of concept cars by providing a means to invent, test, and communicate features within a larger system cheaply and efficiently before resources are poured into the next phase of the design process.



Figure 5: The Concept Car vs. Experiential Prototyping —Prototyping Features to Experience and Inspire Design.

EXPERIENTIAL PROTOTYPING: A New Method for Designing Systems

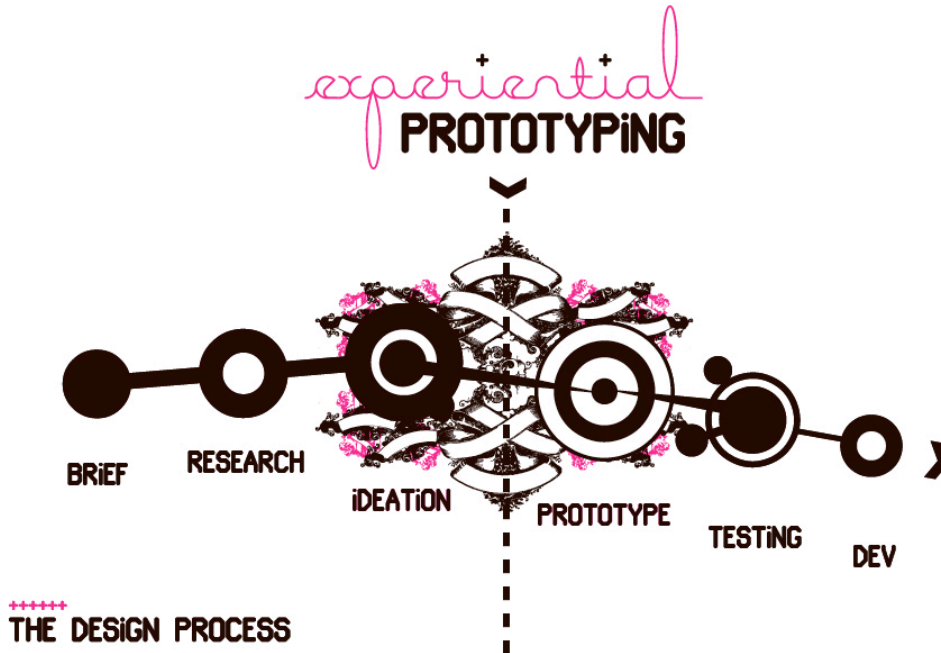


Figure 6: Experiential Prototyping in the Design Process

Experiential Prototyping is a method that is inserted between the design brief and prototyping phases of the design process. It is a method that builds upon traditional design disciplines in the creation of products, services, and technology in a variety of disciplines, and widens the boundaries as it strives to create experiences beyond just products or services. Through the merging of user-based narrative with tangible interactions, a designer or team of designers can interactively prototype a complex system involving products, services, and technological infrastructures in a real world context. Sensors, microprocessors and media are used to turn ethnographically researched stories of real people's lives into an interactive activity that examines specific features within the system. This interactive activity creates an experience that communicates the potential of a new system to a design team, to an organization, and to potential investors. In doing so, it takes research such as ethnographic studies, data collected from target audiences, and an understanding of social behaviors and patterns and translates it into a media-based story that

contextualizes “blank spaces”. These blank spaces are moments where innovations occur, where devices and interfaces are invented using the context of the story, and the where features are designed that are unique to the individuals using the system.

STORYBOOK INVENTIONS: Examining Narrative for Ideation and Concepting

For example, I examined the use of story to inform and inspire solutions for complex and interactive systems within a collaborative design team. The initial creative brief for this project was to design a personal communication device as part of a system that enhanced the music experience. I began by writing a story about three characters whose lives intertwined as they spent the day on Melrose Avenue. They shopped, listened to music, and connected with each other using ubiquitous devices and ambient displays embedded in their clothing and in their environment.

In writing the story, characters’ personas would be based on user and ethnographic research. Using the vernacular of classic children’s storybooks, the story was told purely through graphics, with a written story hidden inside the French-folded pages for additional background. Removing any reference to a specific device or display and replacing it with a circular symbol put emphasis on the experience that the characters were having within the context of the story rather than the devices themselves. It created “blank spaces” for innovation. The blank spaces were the driver for invention. Thus, as importantly as it was for story to inform design, it seemed of further significance to have blank spaces within the visual story to drive the invention process.



Figure 7: Storybook Inventions—Blank Spaces

The storybook was turned into an invention's kit and sent to a multi-disciplinary design team that I selected to see how this technique inspired them. The team included product, interaction, media designers, engineers, and writers.

The experiment resulted in a variety of solutions, all of which overlapped in some way. Collectively, we designed a system based on a personal device that acted as a mobile hub to the environment within the context of the story. The designers agreed that this technique helped provide the context to design within, since the system had the potential of including many variables. It allowed for the designers to focus on specific features within the system yet left enough room for invention. The "blank spaces" were essential to the success of this experiment.



Figure 8: Storybook Inventions—Collaborative Solutions

Not only were the "blank spaces" essential to the success of the experiment, but also the diversity of responses that were generated by a multi-disciplinary team helped to generate varied and creative solutions to a cultural context. This sparked the innovative process by creating a variety of brainstorming ideas that were synergistically more than one designer could create.

The key here was to provide a specific context to design within, while leaving enough latitude for innovation. It was an effective exercise and provided some inventive and useful results. For example, 100% of the responses focused in different ways on personal mobile devices. More than half of the responses to the storybook inventions kit came back with similar solutions involving a hand-held device, demonstrating the team was moving to a shared vision throughout this process. However, each device was somewhat different as a result of the different interaction needs in the blank spaces of the story. For example, one device was handheld and resembled the workings of a PDA. Another device that was invented was a flexible display worn on the wrist. It included only the features necessary for the interaction needs in a specific moment of the story. In sum, this was a successful approach both to create a diversity of responses in order to build the creative outcome and to get multi-disciplines working toward a shared vision for complex technology-driven product/system design.

A provocative moment in the story occurred when the main character stood up from her lunch and started dancing and mixing music using her personal communication device, which ubiquitously linked to an interactive flyer, posted on the light post next to her. The “blank space” in this moment made me wonder what would happen if her device was connected to a library of music and from which she could access the music from the flyer, share it, and mix it through her dance moves.

This moment led to the invention of a new mobile music experience that was an open-source system and that allowed one to make, share, and mix music through gestures. The system was invented and designed through the Experiential Prototyping method.

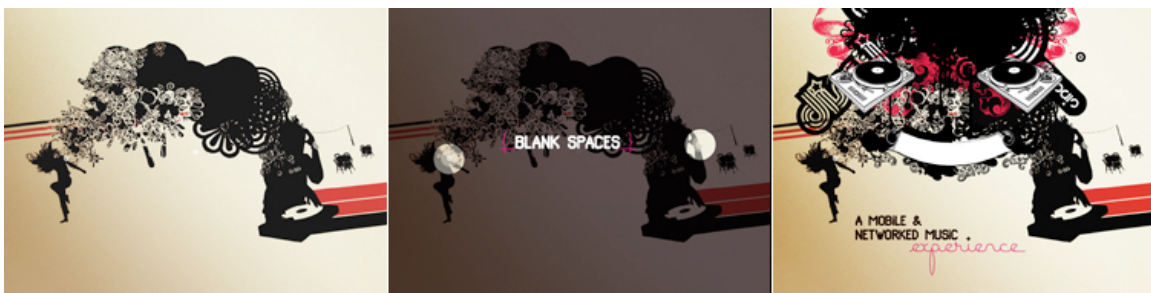


Figure 9: Storybook Inventions—An Examination of Blank Spaces

EXPERIENTIAL PROTOTYPING CASE STUDY: BoBi: A Mobile Music System

First, the story was developed based on three real people who would use the system. Each of their personalities and behavioral needs were different and required completely different uses of the system. The “blank spaces” in their stories and behavioral needs allowed for features to evolve, hence defining the system. The features were built as a working model and merged with the story resulting in an Experiential Prototype.

One system that I used to illustrate this was a music system. Here’s how the system worked. The main concept of the music system was that it acted as an open source of sounds and gestures. The device, represented as a small, ping-pong ball-like object that was movable and could be attached to a person’s body on things like clothes, hats, shoes, etc., could be used to play, make, share, and sync electronic loops. It acted as the music hub that became a mobile music library configured and accessed by other components such as a computer or cell phone.



Figure 10: User-based Narrative Defines the Features of the System

There were four main features that were invented in this system: play, make, share, and sync. Each feature was evolved based on the story and profiles of each character. Here are the key aspects of their profiles based on their stories:

Aaron – the dancer**Feature: mixing through dance moves**

His personality and behavior led to the feature of mixing loops through dance gestures. Loops are played through dance moves. An individual move played a loop for a few seconds. Repeating the move kept the loop playing. He combined moves to combine loops until an entire song was composed through dance. His moves made his music.

Theo – the musician**Feature: making and sharing**

The next character is Theo, who's a musician. He wanted to use the system to make his own custom loops and share them with his friends. This need expanded the system into other devices such as a web-based application and cell phone and started defining the technological infrastructure of this complex system. Theo used the device to record custom loops from instruments, edited them using a web-based music application, and downloaded to his device. He could then share his music library with his friends by making a "pouring" gesture over their device. This gesture transferred his library into others' giving open source file sharing a tactile dimension, almost tangible through vision and gesture.

Angel – the socialite**Feature: synchronizing with others**

The third character is Angel, who's the socialite. She loved to hang out with her friends and mix music with them. Since each of the characters have a variety of loops in their libraries all with different tempos and keys, her need inspired the feature of syncing to evolve into the system. The syncing feature allowed the music to automatically sync to another's tempo and key making for group or socially composing music through movement. To change the tempo and key, the group had to stop. The person who started again became the leader, and all loops synced to his/her tempo and key.

Each feature that was defined by the character's story was turned into a working model to test the viability of the solution. Similar to "blank spaces" in the story, I used a "blank" shape that represented a device. These "blank devices" focused the potential experience and interactions of the system rather than specific

forms of the individual devices, which inspired design and form for products and services at a later stage. In this case I am making an analogy to the “primitives” (sphere, cube, cone) that are dropped onto a plane when beginning a model in a 3d application such as Maya or Alias. This directed the focus away from the form of the device and toward the design of the interaction and experience within the context of the system.



Figure 11: Blank Devices and Working Models

The working models provided inspiration to further the design of the system. For example, once the mixing feature was built into a working model, one could put the device on a different part of his/her body. By doing this, the device might respond to the same motion, but the difference in body location forces a person to make a completely different movement evolving the system into a richer experience and solution.

What the experiential prototyping method of this music system demonstrated was that by starting with a narrative, the personalities and behaviors of the real people who would use the system allowed the design and experiences to evolve based on their needs. The method also helped to focus in on simple interactions and features making it easier to design and test the viability of the components that make up the larger, more complex system. The combination of the working model with the narrative put each feature in the context of the system as a whole. The

stories coupled with the working models provided clues into the lives of potential users, their personality, and behavioral patterns, and helped ground the experience of the prototype in their context.

AN EXAMINATION WITHOUT NARRATIVE

What does it mean to ground the experience in the character's context? Let's look at an example where the use of narrative was taken out of the process. The following is a research project done prior to the music system. The method began with the same brief: make a new music experience, but removed the use of story-based inventions. The solution was an interactive installation that covers the entire façade of the Guitar Center, a music store on Sunset Boulevard in Los Angeles, turning it into an interactive guitar playing experience. Each section represented a set of six strings similar to that of a guitar. Touch them and they pluck, walk by and they strum. I then took a section of the façade and used sensors, microprocessors, and materials to build a working model to evaluate the viability of the interaction and ultimately communicate it to a wider audience. The result was a tangible interface that lacked context other than the location in which it was designed. But what I learned from this project is that it provided valuable knowledge of making working prototypes using sensors, microprocessors, and materials. Although beautiful in its prototype state, the solution was weaker than if it had been invented from a story based on the behavior of a user.



Figure 12: Guitar Center—An Examination of Working Models

APPLYING THE EXPERIENTIAL PROTOTYPING METHOD TO MANY CONTEXTS

The examples thus far illustrated the Experiential Prototyping method within the subject of a music experience. However, the method can be applied to any subject and used in the design process to approach the design brief in any context. For example, the following project is a system designed within the context of the running community. I began by translating user-based research into a story about three characters whose personalities and behaviors help define the system and features within it.

In the story, there was one moment where the characters wanted to go on their daily run together, but one of the characters was out of town that day. Based on this blank space in the story, I designed a system that allowed the characters to run together while they were in different cities. The system included multiple components such as an interactive shoe, a communication ring, web site, database, and a technological infrastructure. Within the system, one of the devices included a shoe covered in color-shifting fabric that kept track of their pace. Green meant they were ahead, red meant they were falling behind, and the middle of the spectrum such as orange meant that they were running at the same pace.

I then took the shoe feature and built a working model to test the interactions and get a sense of the overall experience. The working model was not a study in product form, rather it was used as a “blank” device to sketch the experience of the interaction within the context of the story. I used an off-the-shelf shoe, sensors, and a microprocessor that was available to me to simulate a working experience that I merged with an interactive story that allowed me to test the viability within the context of the larger system.



Figure 13: Run—Experiential Prototyping in Other Contexts

The Experiential Prototyping method's use of narrative helped define specific features within the larger system allowing the design and experiences to evolve based on needs of the characters. Making a working model of a portion of the system brought the design to life. Combining the two provided a strong sense of the overall experience of what could be very complex. As talked about earlier, the concept car prototypes features and experiences that inspire designs for production at a later stage. For complex systems, the Experiential Prototyping method provides just enough of the experience to inspire design for the next stage of the design process. As the features are being invented through the use of the stories, they are turned into working models to test and evaluate. The combination of the story and the working models are touchable story-driven design experiences called Experiential Prototypes.

EXPERIENTIAL PROTOTYPING: A New Role for Designers

The entire process, from translating research into stories, to inventing features and systems, to the final pitch, guides collaborative teams in the ideation phases using the combination of research-based narrative, interactive scenarios, and working models used for evaluation and communication of new system ecologies. The outcome of this new method is not the ultimate design; rather, it is an outcome that allows for communication and evaluation of a product or process before it is fully built and prior to the next stage of the design process. It merges narrative with working models to provide context that leaves just enough blank space for inspiration among the design team members. In addition, "one of the biggest challenges within an organization is to sell the idea," Bevan states. Collaboration is essential for designing successful solutions and requires a method that guides design teams in the ideation, evaluation, and communication phases of the design process. Experiential Prototyping achieves this through:

1. **Invention:** employs the design team to invent systems and features within the context of the story through the use of research-based stories.

2. **Evaluation:** invites the users to test specific features within the system and allows the design team to test interactions and features to refine through the use of “activity spaces,” simple models and functional interfaces.
3. **Communication:** conveys the system to an organization or to potential investors through the combination of research-based stories that have been translated into visual solutions and working tangible models.

So why is it important for media designers to lead this new practice of design? The complexity of interactions in our new world of the ecology of systems is exponential. There is now an infinite amount of variables to work with. As people and objects interact in a fluid and invisibly networked system of tangible artifacts and data spheres, the technological infrastructure requires a more sophisticated approach to design. Experiential prototyping offers this more sophisticated approach to design.

It features the use of social narrative, resulting in both research into 1) the desires of potential users and 2) the different ways real people would relate to and use not only the product by themselves, but also with other people, with other objects, and within the environment of the infrastructure which supports the usage.

The benefit is an incredibly rich, layered and inexpensive way to prototype, dialogue, and enlarge the scope of new and innovative products, the infrastructure that supports the product in a way that is “user friendly,” and the ways in which actual people will interact with and experience using both product and infrastructure simultaneously. In other words, the benefits of Experiential Prototyping include: 1) creating a better context for understanding the social context of new products and systems, 2) building an environment for very productive brainstorming and ideation around stories and prototypes, 3) moving the testing of interaction to an earlier stage of the design process, which will save money and development time, 4) facilitating a more interdisciplinary process, bringing the ideas and expertise of team members into the design as early as possible, 5) providing the opportunity to test and question basic assumptions in the design brief at the earliest and most important stage of product definition, 6) expanding the potential for developing useable features for a system before it is built in its finished form, 7) providing a method for

developing a successful solution during the ideation and prototyping process, and 8) providing a means to move a collaborative team toward a shared vision.

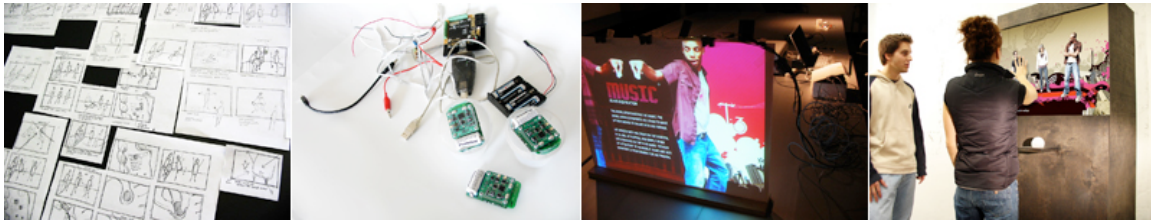


Figure 14: Sketching Interaction—A New Process for Designers

The future of media designers is to participate in the design process toward a better understanding of complex systems and toward innovative, collaborative solutions. The world is becoming increasingly prevalent with technology and the technology is spilling over into new tangible forms such as wearables, interactive retail, and a plethora of networked devices that we wear, carry, or use in our environment. Media design must, therefore, play an important role in using storytelling techniques to translate user-based research into design solutions that simultaneously “sketch” the experience of social interactions and the placement of the interactions in the context of a networked and technologically ubiquitous environment. It gives a simple way to prototype the resulting innovative solutions within the complexity of the new ecology of systems. Experiential Prototyping does this. This method expands storytelling design solutions with a basic understanding of electronics, sensors, and programming integrated into these new design systems. The method is a new way for media designers to participate in the process in order to design innovative and successful solutions for the new ecology of systems.

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