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# AniThings: Animism and Heterogeneous Multiplicity

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**Abstract**

This paper explores the metaphor of animism as a methodological framework for interaction design and, in particular, advocates for a form of animism the authors term 'heterogeneous multiplicity.' Animism can make valuable contributions within ubiquitous computing contexts, where objects with designed behaviors tend to evoke a perception that they have autonomy, intention, personality and an inner life. Furthermore, animism that supports heterogeneous multiplicity offers unique opportunities to stimulate human creativity through embodied engagement with an ecology of things. To demonstrate the concept of heterogeneous multiplicity, the authors present a speculative design project, AniThings, that intertwines multiple animistic collaborators to position activities of digital resource discovery and curation beyond the narrow domain of recommendation engines and personal feeds. The project illustrates an ecology of six tangible, interactive objects that, respectively, draw from a variety of digital resources and inhabit a range of variously positioned stances towards their human collaborators and each other. This diversity of behaviors, resources, and positionality makes AniThings ideal for supporting open-ended ideation and collaborative imagining activities.

**Author Keywords**

animism; heterogeneous multiplicity; ubiquitous computing; speculative design; design fiction; creative collaboration; ecology of things

**ACM Classification Keywords**

D.2.2 Design Tools and Techniques [Miscellaneous]; H.5.2 User Interfaces [Theory and Methods]; H.5.2 User Interfaces [Prototyping]

**General Terms**

Design; Theory; Experimentation

**1.0 Introduction**

Within HCI and related fields, researchers have long pointed out that humans have a propensity for attributing intelligence or personified intentionality to machines [23, 27]. In AI fields, this observation is also an aspirational one, framed by the elusive challenge of a Turing-test passable computer [25]. However, by targeting the simulation of human intelligence as an ultimate end goal, classical AI has tended to privilege anthropomorphism over other forms of projected sentience. By contrast, alternative or interactionist approaches to AI, have shifted emphasis away from human intelligence, instead advocating for the situated AI of ‘autonomous agents’ [21]. Other research has similarly sidestepped ontological questions about human subjectivity by exploring the pragmatics of human machine interaction in terms of ‘affective computing’ [18], and design researchers have applied this concept to sociable robots [6].

From humanities and STS fields, theoreticians similarly have emphasized nonhuman forms of agency [9] and pointed to the vitality or vibrancy of matter [3]. This

idea, that material forms have a “life” of their own, takes on particular potency when designed objects accrue interactive features, becoming what Sherry Turkle calls ‘relational artifacts’ [26]. Within alt.chi, research has similarly explored this imagined “inner-life” of objects through projects such as a vehicular lifelog that supports human-car relationships [12] or moving TV screens which orient preferentially towards certain participants over others [13].

Side stepping the gravitational pull of anthropomorphism, we instead advocate here for the notion of animism as a more appropriate metaphor for interactive systems that invite users to imagine an inner-life of objects. This position takes inspiration from Brenda Laurel’s writing on ‘designed animism’ as a network of “individual perception-representation-action loops” [10]. Laurel’s framework draws on an ecological metaphor as a way of linking animism to the notion of emergent systems.

Existing design research, however, has yet to unpack the particular methodological strategies and opportunities unique to the animism metaphor. Such an approach, we argue, directly engages with the myth-making narrative tendencies of the human mind.

In this paper, we hone in on a form of animism we call ‘heterogeneous multiplicity’ in which a diverse collection of tangible things supports an ecological model of interaction. Instead of narrow recommendation engines and personal feeds, these animistic physical objects form an active, intentioned space for inspiration, serendipity, and imagination.

In our design fiction example, AniThings, a team of animistic devices play a role in a designer's studio, working on their own as well as participating with the designer. The AniThing objects daydream, find inspiring references they're interested in, do research on request, as well as collect and share their findings with each other and the designer through text, visuals, video, sound and networks. They each behave with a distinct personality and approach, seemingly having their own intentions, history, interests, and moods. This creates a wide field for the user from which to select, reject, query, imagine, and investigate. The system relies on the user's intelligence, imagination and divergent thinking instead of trying to explicitly solve problems or be overly "smart."

### *1.1 Background*

Developmental psychology has demonstrated that from an early age people ascribe lifelike qualities to inanimate things, including intentionality and consciousness. In Piaget's classic model of child development, he identifies the Preoperational Stage for ages 2-7, where children are egocentric and understand the world as if everything is like them. In this stage, they use a kind of magical thinking that includes an animistic view of most things, for example that cars can "know where they are" [17]. And more recent research has examined animism in children's experiences of robots [4]. Yet, even at this early stage of life, it is not necessarily the case that children think that cars are literally alive. As Inagaki and Hatano have found, children may be using a "constrained personification" to make predictions about things, relying on humans as an analogical "base domain" to compensate for their undeveloped cognitive abilities and limited knowledge of the world [8].

This innate use of animistic metaphors is what motivates the ideas presented here. In many ways, adults have the same challenges that Preoperational kids have – interactive systems are often too complex to be worth deciphering, or even possible to accurately and rationally understand. So as domain novices, we make up shorthand myths because animistic metaphors provide a framework that is roughly accurate. As adults, we are different from children in that we rationally know that inanimate things don't really think. Yet at the same time we apply constrained animistic models, just like children do, because they provide reasonable predictions.

For example, when a car navigation system steers us wrong, we may think "the car has lost its way" invoking a mental model of a traveling companion who is a lost navigator. "The car is lost" is a more useful shorthand than the complexities of why the GPS failed, which is likely not actionable. Indeed, it is so easy to fall into these metaphors that we often involuntarily interact with our cars, computers, phones, houses, etc. as if they were alive in some way. However, designers of interactive systems often fail to account for, leverage, or design in anticipation of these ascriptive capacities of users.

Donald Norman echoes this point in criticisms of contextually "dumb" features of adaptive cruise control. By contrast he elevates the horse, with its rich array of communicative behaviors—skittishness for example—as a provocation that might likewise help us to conceive interactions with computers as a kind of interspecies communication [16]. Animism as a design metaphor can effectively integrate and express the interactive system's designed intentions, affordances, limits,

status, history, expertise, and reliability/fallibility. Given the familiarity and power of personification, this paper proposes that designers embrace this propensity of humans to ascribe inner-life to machines.

The tendency of humans to ascribe intelligence to systems based on limited evidence has been criticized as “delusional thinking” by Joseph Weizenbaum, creator of the famous *Eliza* text-based therapist simulation program [28, 29]. But others like Janet Murray have celebrated the so-called *Eliza* effect as a kind of dramatic suspension of disbelief [15]. And Noah Wardrip-Fruin complicates Weizenbaum’s concerns by pointing to the inevitable breakdown of the illusion that occurs when *Eliza*’s canned responses eventually become predictable [28].

Animism, as distinct from anthropomorphism however, offers a way of separating out issues of ascribed intelligence from ascribed intentionality or inner-life. When a user engages with animistic objects, the objects begin to take on a life of their own in the user’s imagination. Turkle has described this process as the move from stable “transitional objects” to contemporary relational artifacts, in which “the psychology of projection gives way to a relational psychology, a psychology of engagement” [26]. Like Turkle’s notion of ‘relational artifacts,’ animism is not *merely* about projection. Animism as a design metaphor also suggests an engagement with the creative capacities of users and a taking seriously, or opening up of, the practices of myth-making about, and through, objects as a modality of distributed cognition [7].

### 1.2 Animistic Design Principles

The ideas presented here are an outgrowth and integration of van Allen’s previous work on ‘Productive Interaction’ [2] and ‘The New Ecology of Things’ [1]. This work proposes an approach to interaction design that foregrounds the meaning making role of people as they interact with an ecology of heterogeneous, tangible, networked objects that behave in the world and acquire narrative, mythic qualities in people’s lives. In parallel, McVeigh-Schultz *et al.* have used the concept of ‘ambient storytelling’ to explore the ways that objects “see” the world through sensors and utilize narrative to foster relationships with their users [11].

By deliberately supporting an embodied fiction through the metaphor of animism, designers can leverage the myth-making narrative capacities of people, and enable more fluid, productive, and meaningful relationship between humans and interactive systems. And by designing behaviors around this simulated inner life, we can build ecologies of interactive objects and spaces that allow people to leverage the power of fast computation, sensing, actuating, and large databases in a productive, imaginative and collaborative manner.

Animistic systems can be especially appropriate for contexts where people (individuals or groups) are in a creative, generative mode where they are problem-setting and inventing. These contexts include professional roles such as writing, architecture, design and law, as well as personal activities such as vacation planning and house-hunting, where multiple goals, complexity, and the intention to create a unique and appropriate “fit” is a priority. Such contexts call upon divergent thinking and cross-domain creative solutions.

There are two key principles in this animistic design proposal, animistic mental models and heterogeneous multiplicity.

### *1.3 Animistic Mental Models*

Using animism as a metaphor, designers can create simple yet powerful mental models that people can use for their digital devices, environments and systems. People are expert at and comfortable understanding things that are alive, and this provides an efficient and expressive shorthand for the designer to communicate the system's approach, affordances, and state.

As a consequence, animistic design enables people to build a working understanding of complex systems through their own experience, intuition and tacit knowledge. And through these mental models, animistic systems have the potential to be highly evocative, creating the kind of emotional, mythic, and narrative character that is common in our non-digital objects like books, mementos, or hand tools.

### *1.4 Heterogenous Multiplicity*

By creating a chorus of voices and actions, designers can leverage the discerning, associative, adaptive and selective qualities of people, and sidestep the unattainable goal of being contextually appropriate and useful all the time. These animistic ecologies can have individuals that are more simple, even "dumb," while at the same time, more provocative, diverse, and stimulating.

With an animistic system that provides a heterogeneous multiplicity, the user benefits from a range of perspectives that they become familiar with over time. They can focus on one or another device, ask for more input from a particular perspective, and have broader opportunities for helpful serendipity.

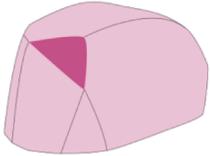
## **2.0 AniThings – Creative Collaborators**

In a summer research project on animism our collaborators developed a framework for thinking about Animism, and created several exploratory projects. AniThings was one of the final outcomes, a design fiction expressed as a series of short video simulations demonstrating how a collection of animistic objects assist someone in a creative field. It's important to note that AniThings is not a product or service proposal, but a speculative project that probes a range of possibility for animistic design in a context. Its intent is to stimulate further discussion and design explorations around animism. In this sense, AniThings draws from the methodological investments of design fiction [5, 19, 22], and extends previous research within alt.chi that argues for design fiction as an important methodological innovation within HCI [24] [12].

In the fiction, our protagonist Stella is presented as a product designer for Philips Healthcare, working on personal electronic health monitoring devices for children and adults. She has an array of six "AniThing" devices with different personalities and capabilities. Their behavior is expressed through a combination of visual display and sound, as well as how they influence each other. Stella interacts with them directly through touch, and indirectly by using one device to control others.

Instead of solving a specific goal or task (e.g. buying an airline ticket, finding an answer to a question), the AniThings are designed to enhance the exploratory, divergent, and productive process that's common to creative inquiry. Donald Schön describes this reflective practice in terms of the open-ended process of *problem-setting* rather than *problem-solving* [20]. And Keith Murphy has described the importance of inter-

**Needy**



**Figure 3**  
Needy: Seeks attention, provokes and interrupts other AniThings and people.

**The Nerd**



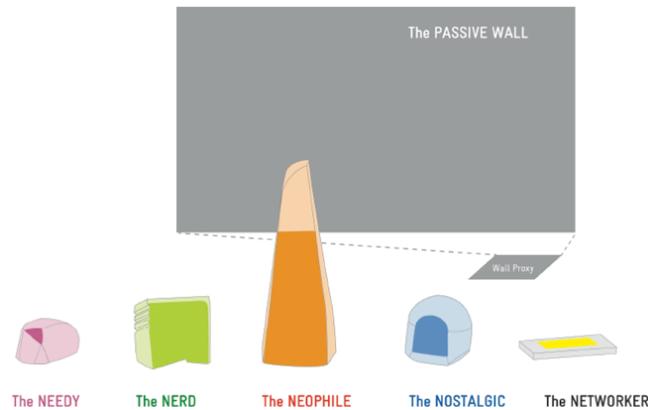
**Figure 4**  
The Nerd: Extremely structured and organized, geeky, persistent.

**Neophile**



**Figure 5**  
Neophile: Proud of finding new information, fast, manic, short attention span.

subjectively situated objects and gestures in scaffolding what he calls 'collaborative imagining' [14].



**Figure 1:**  
A depiction all six AniThings devices

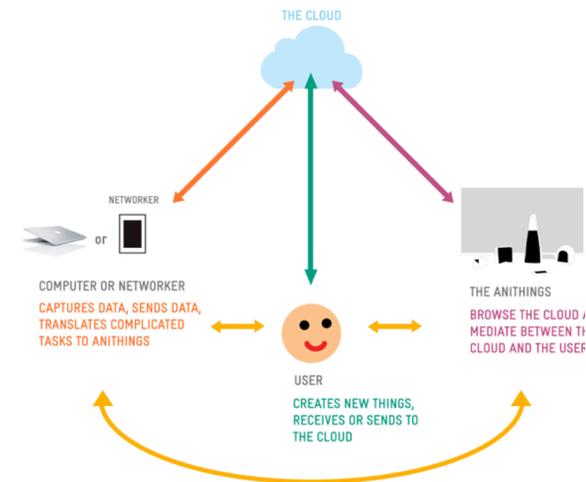
In animistic fashion, the AniThings [Fig. 1] are designed to have a life of their own, each with a different approach to "living" that life. Their personalities are Needy, Nerd, Neophile, Nostalgic, Networker, and Passive Wall. Each has different life-experiences and knowledge, and offer unique perspectives and ways of helping Stella. They are a team of sorts, and as such, work with (and sometimes against) each other as well as interacting with Stella in a creative process. Note that the physical shapes of the AniThings are meant to be abstract rather than literally animistic, and definitely not anthropomorphic. The animistic design was focused primarily on the device behavior rather than their physical appearance.

**Needy** [Fig. 3] is a simple creature that mainly instigates the others. It is very emotional/reactive (think "drama queen" or cat), with a tendency to be manipulative or interruptive.

**Nerd** [Fig. 4] is fixated on trivia and informational research, extremely structured and organized, and can be little bit pedantic or geeky (think idiot savant).

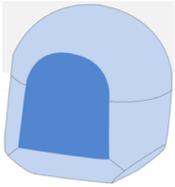
**Neophile** [Fig. 5] is only interested in collecting new data. It takes pride in finding things as quickly as possible, tends to be manic, and has a short attention span (think hummingbird mentality).

**Nostalgic** [Fig. 6] dwells on things you have already collected. It likes to slow down and focus, and is usually relaxed or dreamy (think "old dog").



**Figure 2**  
AniThings system diagram

### Nostalgic



**Figure 6**

Nostalgic: Dwells on existing user information, methodical, focused, sometimes dreamy.

### Networker



**Figure 7**

Networker: Mediator/wrangler/translator for the other AniThings, can temporarily embody other AniThings' spirit/knowledge.

### Passive Wall



**Figure 8**

Passive wall: Shy, displays its own findings, but is often taken over by other AniThings.

**Networker** [Fig. 7] is a portable mediator and translator for the other AniThings. It is amiable and flexible, a multi-tasker.

**Passive Wall** [Fig. 8] is a wall (large screen). It can be shy or sometimes passive-aggressive. By default it displays its own findings, but has little confidence and relinquishes control if any other device wants to show something. (More like a plant.)

The AniThings have full access to Stella's cloud data [Fig 2.], including her current and past design work, notes and other writing, books and videos, reference materials, research, and even selected personal data like her music collection, because she thinks it might provide inspiration. In addition, the AniThings can access any other external data set Stella designates, as well as the entire Web.

The AniThings are an imaginative collection of creative collaborators whose primary function is to produce inspiration for the owner through alternate perspectives and interpretations of content. They do this by making deep connections for her or simply stimulating her mind to create metaphor. They have a shared history with the owner, which allows for a deeper relationship and emotional attachment to them. This framework was further elaborated on research assistant Brooklyn Brown's website:

By giving a sense of inner life to a system or object, owners may feel differently about each device and can seek recommendations from them the way they would a trusted friend. By exploring this idea without literally anthropomorphizing the devices or making them feel human, we wanted to

design a system that felt friendly but still distinctly other, more like an animal or other biological system that is adaptable.

The video scenarios show a progression of Stella's design process, from inspiration, to discovery, concept development, and collaboration. Throughout this process, Stella works with the AniThings devices, both individually and in combination.

The diverse and atomized behavior of the AniThings creates a wide field for Stella, and is designed as a more active and intentioned version of the kind of serendipity that used to happen when one would walk through the stacks of a library. It's also intended as an antidote to the narrowing field of the ever more personalized feeds of the digital age.

The interaction designer is therefore freed from the constraint of making something that tries to come up with "correct" answers. Instead, the focus shifts to designing systems that productively participate in the creative process through novel or serendipitous contributions. In this way, animism offers the chance to create digital ecologies that stimulate human intelligence and creativity rather than emulate or replace it.

In the Stella scenario there are five short video simulations [Fig. 9-13]. The first four focus on a different outcome and manner of interaction as the design process progresses. The last one demonstrates specific behaviors and interactions with the AniThings. These are outlined in the sidebars below with links to short videos for the reader's viewing.



**Figure 9** [vimeo.com/26421875](https://vimeo.com/26421875)  
*Relax*: When the owner is away, the AniThings relax, daydream, or sleep. They independently browse through content they have already accessed, or are instigated to search for new content by an external stimulus, or sometimes without an identifiable cause.



**Figure 10** [vimeo.com/26461671](https://vimeo.com/26461671)  
*Inspire*: The owner of this set of AniThings, Stella, arrives in her studio expecting to find them relaxing and daydreaming. To her surprise, they all seem to be engaged in the original movie *Tron*, which she had almost forgotten she had in her library.

In the video scenarios [vimeo links in Fig. 9-13], one sees a different relationship between Stella and her digital system than is common when working with conventional computational devices such as mobile phones or tablets. The AniThings utilize the following characteristics.

### 2.1 Animism

The interactions are more of a conversation than the typical command and response pattern that is typical of the relationship between a “user” and an “interface.” The AniThings make contributions, usually related to the current topic, but not necessarily in direct response to a request by Stella. These behaviors and expressions seem to come from a unique internal set of needs, wants, and motivations that over time provide a certain predictability, not of content itself, but of the quality and character of the content.

It also moves away from a master/slave model for interacting with our digital devices. As they gain their own points of view and independence, animistic devices can put people in the position of collaboration and assessment versus domination and dependence.

### 2.2 Multiplicity and Heterogeneity

Animism offers an alternative to the single channel approach to computation. It avoids the inclination to strive for a monolithic truth, and instead allows for and encourages multiple and heterogeneous points of view. We can take in the viewpoints of a range of animistic systems, and shape our own conclusions.

In the AniThings project, there are six different devices, each behaving in a different way based on its animistic personality (e.g. history buff, obsessive compulsive).

Because of this, Stella expects a historical mining of her data from the Nostalgic AniThing, whereas from the Nerd she gets highly organized and deeply researched information.

### 2.3 Embodiment

The separate physical embodiment of individual personalities reinforces people’s tendency to imagine that *things* are alive, and removes the extra mental leap needed if the systems were virtual. This presence in Stella’s personal space also affords an easier mental separation and localization of the personality and concepts represented by each AniThing.

For example, Stella might think: “The one concerned with quirky inspiration is over here, on my left. The one digging into my history for related design work is in front of me on the desk. And I’ve hushed for the moment the one on the right, which was nagging me for more details about parts cost for this design. Right now I’m focusing up to the Passive Wall to get an overview what everyone is contributing.”

### 2.4 The Human is Smart

To be clear, the intention of the AniThings project is not to use some future super-artificial-intelligence to achieve their behavior. Instead, the system can be relatively “dumb.” It’s the human in the equation that’s inherently smart and adaptable, drawing inspiration from, ignoring, or rejecting “low” quality or seemingly off-topic contributions. This fault tolerance is further enhanced by the distinct and transparent perspectives of multiple devices, enabling the person to turn their attention to the one that’s most interesting, or take in an emergent gestalt formed by a group of independent AniThings.



**Figure 11** [vimeo.com/26465860](https://vimeo.com/26465860)  
*Research:* After developing an interest in wearable technology thanks to inspiration from her AniThings, Stella has them gather more specific references. Each finds things from its own perspective. A user gestures to save or retrieve a finding.



**Figure 12** [vimeo.com/26467409](https://vimeo.com/26467409)  
*Share:* Stella, a medical product designer got inspired by her AniThings and wants to establish a collaboration with Luisa, a fashion designer interested in wearable electronics. Networker can talk to other devices, as well as carry the

This approach is in contrast to systems that use AI techniques to analyze and propose “solutions.” For example, Microsoft’s Clippy in Office used Bayesian algorithms in an attempt to assist users. Instead, it mostly irritated people, and Microsoft eventually removed it due to the criticism and parody it received.

### 2.5 Divergent Thinking

Whether planning a personal vacation, or developing a medical monitoring device, our tools needn’t solve the problem for us, but rather help us explore, identify, and refine what the problem is. AniThings are designed to fit a messy, serendipitous process of constant reassessment, enriching open-ended situations that occupy a significant part of people’s personal and professional lives.

## 3.0 Additional animistic design possibilities

### 3.1 Object Wrangling/Mediating

In the AniThings scenario, the Networker often acts as a kind of liaison to the other devices. This idea could be expanded further where a device serves as an object wrangler. Wranglers could handle the customization, configuration, and communication with other devices. In this way, each device can be focused on particular roles, and not be burdened with providing a full range of affordances and the complexities that go with them. The wranglers are like sheep dogs who take simple commands from people and wrangle groups of devices, such as the dozens of smart objects and sensors that will soon occupy our homes.

### 3.2 Influencing content and process

An important characteristic of animistic systems is that they can actively participate and affect the actual world. In the AniThings scenario, the different objects throw images and text up on the Passive Wall, creating

a montage of content. In a different scenario, imagine a group of people (architects and stakeholders) working together at a large multitouch table, creating a space plan for a new building. As the people adjust the size of different parts of the building, AniThings could jump in and propose different configurations in the digital model, adjusting and moving rooms around on the touch table based on their “interests” and personalities.

## 4.0 Conclusion

Animism is proposed as a strategy for interaction design, appropriate for certain contexts such as creative tasks where divergent thinking is needed.

With the rich mental models that animism affords, and the imaginative potential of multiple, heterogeneous devices in an emergent ecology of things, animistic design offers a potential for new modes and contexts for interaction design. This proposal is a challenge for designers to create beyond the frameworks of strict rationality, usability, and proscriptive experience design. Through animistic metaphors, designers can embrace and facilitate people’s intelligence and imagination, where predefined outcomes are subsumed and instead, productive, open-ended exploration is foregrounded.

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**Figure 13** [vimeo.com/26463852](http://vimeo.com/26463852)

#### Interact:

- Pet: Encourage
  - Tap: Scold
  - Shake: Try something else
  - Swipe down: Remember this
  - Swipe up: Retrieve saved
- The “skin” displays indicate mental state such as confusion, confidence, excitement, exhaustion.

Sean White as Nokia’s liaison, we developed a framework for thinking about Animism and created

#### References

- [1] Van Allen, P. 2007. /models/. *New Ecology of Things*. H. Willis, ed. Media Design Program at Art Center College of Design.
- [2] Van Allen, P. 2004. Productive Interaction: Designing for drivers instead of passengers. *Southern California Digital Culture Group*. University of Southern California.
- [3] Bennett, J. 2009. *Vibrant Matter: A Political Ecology of Things*. Duke University Press.
- [4] Beran, T.N. et al. 2011. Understanding how children understand robots: Perceived animism in child–robot interaction. *International Journal of Human-Computer Studies*. 69, 7-8 (Jul. 2011), 539–550.
- [5] Bleecker, J. 2009. *Design Fiction: A short essay on design, science, fact and fiction*. Near Future Laboratory.
- [6] DiSalvo, C. 2012. *Adversarial Design (Design Thinking, Design Theory)*. MIT Press.
- [7] Hutchins, E. 1996. *Cognition in the Wild, Issue 1995*. MIT Press.
- [8] Inagaki, K. and Hatano, G. 1987. Young Children’s Spontaneous Personification as Analogy. *Child Development*. 58, 4 (1987), 1013–1020.
- [9] Latour, B. 1999. *Pandora’s Hope: Essays on the Reality of Science Studies*. Harvard University Press.
- [10] Laurel, B. 2008. Designed Animism. *(Re)Searching the Digital Bauhaus (Human-Computer Interaction Series)*. Springer. 384.
- [11] McVeigh-Schultz, J. et al. 2012. Extending the Lifelog to Non-human Subjects: Ambient Storytelling for Human-Object Relationships. *ACM Multimedia*. (2012), 1205–1208.
- [12] McVeigh-Schultz, J. et al. 2012. Vehicular Lifelogging: New Contexts and Methodologies for Human-Car Interaction. *CHI*. (2012).
- [13] Mortensen, D.H. “It’s in Love with You” Communicating Status and Preference with Simple Product Movements. *CHI*.
- [14] Murphy, K.M. 2005. Collaborative imagining: The interactive use of gestures, talk, and graphic representation in architectural practice. *Semiotica*. 156, 1/4 (2005), 113–145.
- [15] Murray, J.H. 1997. *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*. Free Press.
- [16] Norman, D. 2009. *The Design of Future Things*. Perseus Books Group.
- [17] Piaget, J. 1959. *The Language and Thought of the Child*. Routledge & Kegan Paul.
- [18] Picard, R.W. 2000. *Affective Computing*. The MIT Press.
- [19] Resistance is Futile”: Reading Science Fiction Alongside Ubiquitous Computing: .
- [20] Schön, D.A. 1983. *The Reflective Practitioner*. Basic Books.
- [21] Sengers, P. Cultural Informatics: Artificial Intelligence and the Humanities. *Surfaces: Special Issue on Humanities and Computing - Whose Driving?* 8.
- [22] Sterling, B. 2009. Design fiction. *interactions*. 16, 3 (May. 2009), 20.
- [23] Suchman, L.A. 1987. *Plans and Situated Actions: The Problem of Human-Machine Communication (Learning in Doing: Social, Cognitive and Computational Perspectives)*. Cambridge University Press.
- [24] Tanenbaum, J. et al. 2012. Steampunk as design fiction. *CHI* (Austin, TX., 2012).
- [25] Turing, A.M. 1950. Computing Machinery and Intelligence. *Mind*. LIX, 236 (1950), 433–460.
- [26] Turkle, S. 2006. A Nascent Robotics Culture: New Complicities for Companionship. *American Association for Artificial Intelligence AAAI* (2006).
- [27] Turkle, S. 2005. *The Second Self: Computers And The Human Spirit*. MIT Press.
- [28] Wardrip-Fruin, N. 2009. *Expressive Processing: Digital Fictions, Computer Games, and Software Studies*. MIT Press.
- [29] Weizenbaum, J. 1976. *Computer Power and Human Reason: From Judgment to Calculation*. Freeman.

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