

We live in a world where everyday objects, digital services, and human beings are increasingly interconnected. This forum aims to offer and promote a rich discussion on the challenges of designing for a broader ecology of materials, artifacts, and practices. — **Elisa Giaccardi, Editor**

Objects with Intent: A New Paradigm for Interaction Design

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Imagine products we are familiar with, such as lamps, jackets, and toys. Now imagine they are given a purpose: The lamp wants you to have a good night's sleep; the jacket encourages you to calm down; and toys wish for you to be active. I call these artifacts *Objects with Intent*. In research carried out at TU Delft, we are developing conceptual designs and interactive prototypes to explore Objects with Intent as a new interaction design paradigm. Here, I present three of these designs and discuss some of the challenges we faced in designing them, with the goal of helping illuminate and frame future research at the convergence of industrial design and animistic design approaches.

Current developments in artificial intelligence and smart materials are bringing forth a breed of products supporting intuitive forms of collaboration between humans and non-humans.

Artificial intelligence (AI), a branch of computational science that focuses on how machines and software programs can make sense of the world and respond intelligently, is increasingly embedded in products for everyday use. Examples are conversational agents such as Apple's Siri, but also robotic vacuum cleaners such as Roomba. These intelligent products can experience and act on the world in specific ways, with intentions and autonomy that allow us to collaborate with them as partners.

In addition to developments in AI, the upcoming field of smart materials allows objects to learn from and be

responsive to physical interaction. Examples are shape-changing polymers and light-emitting materials. These technological developments allow designers to focus on the expressiveness and interactivity of objects in a way that foregrounds the objects' embodiment as the nexus of interaction. This allows us to design the behavior of these objects to be more authentically linked to their physical form.

Given these technological opportunities, the question then is how to design intuitive collaborations between humans and non-humans. The notion of Objects with Intent aims to address this question by framing intelligent products as *embodied agents in human activity*. Considering intelligent products as agents acknowledges that they sense, respond, and cooperate in human activity in an *autonomous manner*. Thus, the design of Objects with Intent must be primarily concerned with how tasks and judgments are delegated between humans and non-humans. For example,

Insights

- Current developments in artificial intelligence and smart materials are bringing forth a breed of products supporting intuitive forms of collaboration between humans and non-humans.
- The design of Objects with Intent must be primarily concerned with how tasks and judgments are delegated between humans and non-humans, and how this delegation is expressed in sensible form.

who takes the initiative, and when? Can behaviors be overruled, and how?

Second, because Objects with Intent are *embodied*, their design must also concern how humans perceive intelligent products as animated and expressive. What can we learn from the subtle cues in body language that are involved in many of our social interactions, and how can we translate these cues into the expressive behavior of objects to support intuitive collaboration? A compelling example is Pixar's animated lamp, which illustrates how an artifact of everyday use and a sentient being can come together into a single expressive object.

INTERACTION DESIGN CHALLENGES

Objects with Intent confront interaction designers with a new set of challenges. To design them, designers must learn how to position objects in human activity as collaborative partners, how to design for shared control between people and objects, and how to design the expressiveness of objects that are mundane, yet intelligent (as they can reason and act autonomously).

How to position objects in human activity as collaborative partners? The three designs described in this article (see sidebar) illustrate how objects can empower us in situations where we are unwilling or unable to act, or are unaware that action is possible. The bedside lamp lulls us into sleep in a stealth-like manner and further urges against actions that wake us. The jacket encourages its wearer to consciously regulate stress by helping him/her to



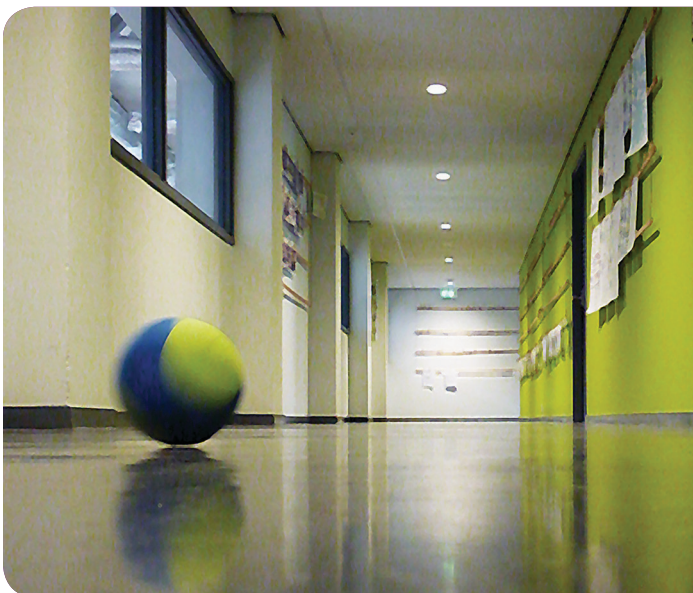
DESIGN DEMONSTRATOR #1. A bedside lamp that lulls you to sleep

One of our graduate students developed a concept of a bedside lamp that lulls you to sleep. Based on the knowledge that certain types of light stimulate the body to produce melatonin, the lamp sets the right lighting conditions to make you sleepy, dimming the light as the evening progresses. The lamp helps you get to sleep on time by making it easy to dim the light further, and also by making it more difficult to increase the brightness by providing physical resistance in the lighting controller. The way in which the interaction is designed gives you the feeling that if you increase the brightness the light, you go against the will of the lamp. The longer sleeping time is postponed, the more assertive the lamp becomes, and the more forceful it will be in its behavior.



DESIGN DEMONSTRATOR #2. A jacket that encourages you to calm down

In a research project that explored new applications of wearable technology, we have developed a concept of a jacket that helps veterans who suffer from post-traumatic stress disorder (PTSD) to deal with stress and anxiety in everyday life. Many people who suffer from PTSD tend to avoid public spaces because of the fear or panic triggered by unexpected events, sudden noises, or being exposed to human crowds. The jacket encourages the wearer to calm down in three different ways; by mirroring the stress level of its wearer through biofeedback, by actively helping the wearer to relax through deep abdominal breathing, and by fixating a person when stress levels are too high to control, which may lead to irrational or even aggressive behavior.



DESIGN DEMONSTRATOR #3. A ball that invites you to be active

In a design research project that is focusing on how hospitalized children can be stimulated to be active, "Fizzy" was developed. It is a ball that invites young children to get out of bed and move around through the hospital ward. Many hospitalized children remain bedridden unnecessarily because the environment doesn't offer much stimulation and parents feel anxious and protective toward their children. Fizzy is designed as an enthusiastic ball that asks for attention by rolling around by itself, inviting children out of their beds. It likes being followed around and tries not to get caught. It does so by rolling away from the child at speeds that challenge children at an appropriate level, installing a sense of trust in parents and caregivers.

become attuned to bodily feelings. “Fizzy” the ball invites hospitalized children to be active by stimulating them to get out of bed, move around, and play.

However, people may be hesitant about interacting with an intelligent product that observes them, collects sensitive information, and acts on their behalf. Let’s consider the bedside lamp. Here you can imagine that privacy is a concern and that people might feel patronized by a lamp that knows better than we do. Fizzy the ball’s invitation to play should be acknowledged in the context of hospital settings that are foremost a place for care, where situations can be emotionally fraught and even matters of life and death. Here the design should take into account respect and security to be appropriate.

In designing these demonstrators, we have learned that for objects to empower people, designers should obtain a critical understanding of the *interdependencies* between human and non-human actors. For example, in the design of the jacket, we acknowledged

the need of veterans to rely on the jacket to calm down. However, we also acknowledged that, in collaboration with the jacket, veterans may learn to internalize this competency, calling on the jacket to adjust its behavior accordingly.

How to share control between people and objects? Designing Objects with Intent involves understanding the objects as *agents*. We have learned how to design the autonomy of these agents based on models of human behavior. In the discussed design cases, the autonomous dimming behavior of the bedside lamp is designed with an understanding of the effect of

light on our physiology; the jacket’s tightening behavior is designed with an understanding of stress-reduction strategies; Fizzy’s rolling behavior is designed based on the knowledge of the natural play tendencies of young children.

However, designers must also consider how people in a specific situation may respond to, follow, or wish to overrule the autonomous actions performed by the object. Situations change, and we should be cautious in thinking that an intelligent product is able to foresee and respond appropriately to any possible situation. What happens when you are running for the bus and the jacket stiffens because it thinks you are having a panic attack? What if Fizzy rolls around enthusiastically in the patient room in the midst of a medical emergency?

These challenges in the design of our demonstrators allowed us to reflect on the ways in which the object can share control, beyond a simple on/off dichotomy. Rather, we describe shared control in terms of *freedoms* and

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efforts. For example, the freedom the bedside lamp allows a person to vary light intensity decreases as the evening progresses, but light intensity can always be increased by overriding the resistance in the lamp's controller. Fizzy adjusts the enthusiasm it expresses in its rolling behavior to a child's vitality level and willingness to play, but Fizzy's enthusiasm can always be tempered when the situation calls for it.

How to design the expressiveness of objects that are mundane and yet intelligent? Objects with Intent are perceived as both familiar artifacts of everyday use (e.g., a lamp, a jacket) but also as animated objects with autonomy, intentions, and an inner life. Because people understand, judge, and interact with *artifacts* differently compared with *sentient beings*, interaction designers have to reconcile how to integrate both perspectives in an interactive design.

We usually judge and bring artifacts of everyday use into our lives based on their functionality and style. For example, we may use a lamp because we need to work in the evening, but we may choose it because of its modern style, to which we can relate. We judge sentient beings based on their intentions, actions, and personality. As such, people relate to them and invite them into their lives. For example, we can consider a product to be friendly or pleasant to collaborate with, as we would do with a person.

Working on our designs allowed us to reflect on how to unify these two perspectives into a single interactive design. We learned that *product character* is a quality that covers both perspectives and can be used to describe the style of the product as well as its expressive behavior as an intelligent agent. For example, in designing the bedside lamp, we used "Mother" as its product character. This archetype informed the physical shape of the product as well as its autonomous behavior.

TOWARD A NEW PARADIGM

As a new interaction design paradigm, we have explored Objects with Intent through a variety of design techniques. This is first and foremost



an exploration of *form*, that is, an exploration of the material basis of the design (i.e., material properties, technical principles, and mechanisms) as well as an exploration of meaning (i.e., as perceived by, made sense of, and appropriated by people through the embodiment of the object).

Creating forms (as broadly defined) enabled us to investigate expressiveness in a technically simple manner. For example, low-fidelity mockups animated by human motion can bring Objects with Intent to life. This allowed us to understand an object's expressiveness in relation to its purpose and intent, and also helped us to critically reflect on its possible implications on human activity. During these explorations, we discovered how combining cinematic techniques with low-fidelity prototypes is a powerful means to realistically speculate on Objects with Intent.

Developing interactive prototypes of Objects with Intent was the next step. It helped us understand the engineering challenges involved in actually realizing our designs. For example, which type of signals should be sensed and how accurate should this be? How simple can computation be to arrive at sensible behavior, and how fast should the system perform? Moreover, interactive prototypes were essential to help us reflect on how objects might "act" as collaborative partners in human activity. They enabled us to investigate issues of shared control and understand how collaboration should

unfold over time.

In our Connected Everyday Lab, we are setting up new design projects and empirical studies to explore Objects with Intent in terms of their societal value, and more fundamentally, in terms of how they are perceived as intelligent and can become collaborative partners in human activity. In this line of research, we address an important design question relating to the growing agency of products: *How can technology help us help ourselves?*

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