Expressing Intent: An Exploration of Rich Interactions

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Abstract

In this paper, we describe Expressing Intent - our initial exploration of rich interactions between human actors and three connected objects – (1) a bookshelf that learns about taste, (2) a radio that determines mood, and (3) a window that augments visual reality. These objects interpret and express 'intent' in a multitude of ways within the context of a shared office space. Objects with intent, or animistic qualities, can evoke diverse reactions from human actors, depending on how they are designed. To investigate the effects of multiple human and non-human actors interacting with self-interest in mind, we deliberately designed each object with distinct needs and values that complement human behavior when placed in a shared office space. The resultant system of interactions involves cascading relations between object-object, human-object and object-human. Further, after our initial prototype, we discover prime areas in interaction design that warrant further exploration. Specifically, the implications of incorporating animism in object design, objects with needs and values independent of their users, and the implications of designing connected heterogeneous ecosystems (i.e. distinct but cooperative objects) vs. homogenous ecosystems (i.e. uniform and cooperative objects).

Author Keywords
Ubiquitous Computing; Smart Objects and Environments; Tangible Interaction; Embodied Interaction; Animism; Internet of Things; Object Intent; Augmented Reality; Heterogeneous Ecosystems

ACM Classification Keywords
H.5.2 User Interfaces [Prototyping]; H.5.2 User Interfaces [Theory and Methods];

1.0 Introduction

When we consider Smart Objects today, they tend to be servile, and still embody a master/slave relationship, where users directly express their intent through control. Historically, many of the computers, technologies and electronic devices we use have been designed for user-controlled direct manipulation. Such conventional computing generally involves computers remaining passive until users issue specific commands for operations whose effect on the object of interest is usually immediately visible, and remains consistent regardless of context. (Maes et al, 97) The advent of ubiquitous and contextual-aware computing, however, brings attention to the tacit assumptions we have about the potential reach, extent and visibility of computers' acting autonomously. Take for example, the recent furore over car manufacturer building software and sensors that deliberately limited harmful gas emitted by cars under emissions test conditions in order to portray them as more environmentally friendly. (Schiermeier, 2015) The public furor it incited reveals a gap between our tacit assumptions and true realm of technical possibilities for intelligent technology to harness a multitude of sensors to execute highly context-specific actions. On the other end of the spectrum, sensational pop culture and mass media representations of autonomous computers continues to incite moral panic, which paints a veneer of speculative science fiction over progressive user interfaces, such as ascribing consciousness and cognition to everyday objects such as self-driving cars. The excess significance placed on such technology eclipses conversations on how pervasive, smart objects within everyday physical spaces acting autonomously can inflect our experience and behavior.

1.1 Background

Existing literature suggests that studies of design interaction and animism still remains nascent. In the work of Van Allen and McVeigh-Schultz (2013), they examined how animistic objects could facilitate the emergence of human creativity. Other related works addressing similar questions include exploring how objects designed to evoke in users a perception of object autonomy could reframe subject-object relationships, particularly in an immersive environment constituted by responsive technology (Beran et al, 2011; McVeigh-Schultz et al., 2012; Rod & Kera, 2010) However, a physical environment which is outfitted with smart objects also involves object-to-object interaction in the context of human actors, which remains a less explored area in interaction design and animism. By deliberately endowing objects with their individual, distinct values and designing them to act according to their own self interest, we investigate how this might inflect the complex nexus of interactions between object-object, human-object and object-human relations and possibly shape human behavior. For illustration purposes, we have chosen the three objects – bookshelf, radio and window to explore these themes. These were chosen due to the context that we decided to work on, which is a semi-private space of a small,

shared office with 2 occupants. However, the resultant dynamics and interactions can be overlaid on other ecosystems with smart objects as well.

1.2 Focus of Exploration

As part of a two-week research project, we have chosen specifically to design objects that would enable us to explore these three areas in a more in-depth manner:

(1) Object animism – Increasingly, objects, machines and technology is infused with anthropomorphic elements that help enhance human interaction with them (Seehra, et al, 2015). Such designed animism, for Laurel, "forms the basis of a poetics for a new world." (Laurel, 2008: 252) whereby said objects' elicit divergent behaviors as an effect of interaction (Zuckerman and Hoffman, 2015). These additions are not merely functional, but incorporate the dimension of empathy and enchantment that makes human-computer interactions alluring (Gell, 1992).

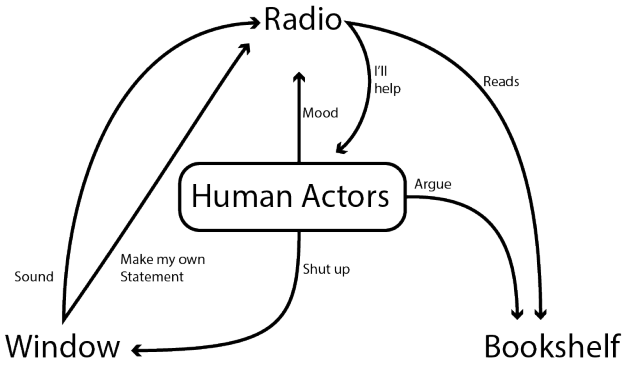
(2) Rich Interactions –When designing interfaces for interactive products the dominant paradigm at the moment seems the be touch screens. Although, the digital nature of touchscreens allows their interfaces to be malleable depending on their mode of use we felt that an overly digital interface doesn't leverage people's innate ability to interpret the expressiveness of their physical world. As a result, when we prototyped our objects we utilized the framework of Rich Interaction (Frens, 2006) and tried integrate form, interaction, and function into each product. Specifically, we have chosen to explore dimensions such as audio output, distance between objects by extending objects' natural affordances with digital abilities, thus creating opportunities for more expressive interfaces.

(3) Heterogeneous Ecosystem –Most of the smart object ecosystems available now are designed to function in closed, hermetically-sealed systems. Information and data are preprogrammed to be transmitted in structured, orderly conduits between objects. As we gradually transit from such systems towards a more a platform-agnostic Internet of Things with more sophisticated abilities, it also raises a plethora of questions about the nature of interactions that these objects constitute.

1.3 Expressing Intent

This section comprises two principal halves: in the first, we (1) describe the three objects and the particular ways in which object animism is expressed through their affordances and features. The second half (2) recounts the several prototypes we have built that enabled us to explore materially the range of interactions that might emerge from such a context.

(1) INTERACTION ECOSYSTEM



Overall, this network of objects forms an intricate web of interactions that creates a much more fluid environment objects that adapt and respond to humans and other responsive objects.

Instead of accomplishing specific, goal-oriented tasks, Expressing Intent is targeted at (re)introducing both serendipity and mindfulness into the continual process of seeking out, consuming and sharing cultural products (such as print, books, music and visuals) within the context of a shared office.

While the two human actors (office inhabitants) are located at the center of the diagram, their interaction with the objects are considerably limited (see object design description for more details). The objects interact amongst themselves in a cascading fashion, similar to the game 'telephone'. The data and information collected by one object bleeds into the shared space, which is in turn internalized, processed and transformed into a new, distorted version of its old form that is again, output into a shared physical space. This spillover effect forms a linked chain reaction between objects that continually collect, transmute and reintroduce data within a fluid ecosystem that dynamically adapts to its inhabitants.

PERSONAS

Bailey the Bookshelf

Bailey wants to be the ultimate purveyor of excellent culture, taste and art. It has an insatiable thirst for knowledge, and constantly prompts you for a steady stream of new content. If neglected, it will search for new owners who will give it the attention it is due. Bailey's self interest in new, novel content brings a new dimension to users and their relationship with print content that is neither subservient (i.e. "what you would you like") or paternalistic (i.e. "you should do this human". By prioritizing a constant, diverse diet of books, its interaction helps guard against stagnation and increasing filter bubbles.

Rocket the Radio

All Rocket craves is peace and harmony. Like a joyful puppy, it enjoys social company and gets excited when someone enters the room. Empathy is Rocket's strong suite and it constantly gauges the mood atmosphere of the room, and responds to it via music. Rocket hates when things get heated, or tense in a room, and immediately tries to placate by playing calming music. Its repertoire of songs is influenced by Bailey's current book collection; when Bailey's book collection stagnates, so does Rockets' musicality. When inspired, Rocket incorporates cultural elements drawn from Bailey's book collection. The more Rocket and Bailey are acquainted, the more influenced Rocket becomes.

Physical proximity is also a significant factor in Rocket's relationship with Bailey. The closer Rocket is situated to Bailey, the more it is influenced by Bailey's cultural content, and consequently the more Rocket's and Bailey's cultural profile (a measure of taste and preference) converges. To get to Bailey's soul, Rocket reads its database of interactions that comprise book titles, both present and past. This inspires it to explore musical genres related to Bailey's books.

The Radio was laser cut from 1/8" plywood, and retrofitted with a depth sensor and the same Arduino

used to sense interaction with the bookshelf. The Radio looked for cues from the bookshelf, and used the depth sensor to change songs depending on the measurement of depth.

Nicky the Window

Nicky fancies itself as an anarchist graffiti artist – his duty to society is to tell the truth; his truth, no matter what it looks like, with honesty. (It can't help it that Rocket's tunes are incredibly infectious). It wants people to see its work, but like most graffiti artists, most of it is concerned about making its own statement rather than engaging others in dialogue.

Nicky couldn't care less about what people think, and sometimes needs to "dial it back" before it becomes bearable. It takes a bit of getting used to and it might remind you of an acquaintance you can only take 'in small doses.'

The Window pulley was fitted with a rotary encoder that enables you to 'dial it up' or 'dial it down' between Augmented Reality (e.g. drawings that turn clouds into animals, or animated people / animals that is indistinguishable from real people viewed from the window) and Abstracted Reality (e.g. blobs or shapes moving). It sometimes chooses to dance to the music Rocket is playing, and things can get wild depending on where Waldo is on the AR scale.

(2) INTERACTION ECOSYSTEM

Bailey the Bookshelf

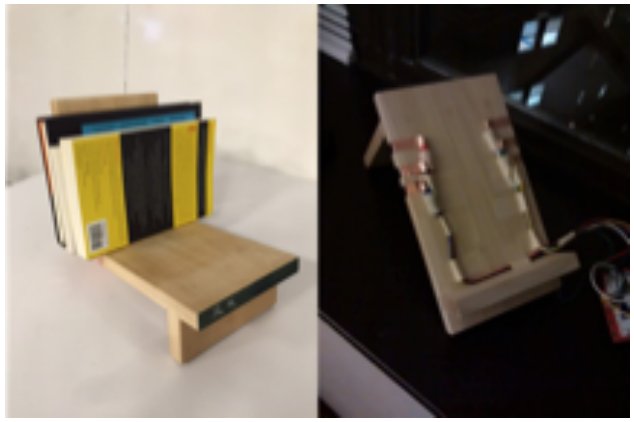


Figure 1. Top view of bookshelf (left), wiring and circuit view of bookshelf using conductive tape and alligator clips to connect to an Arduino (right).

Hardware – The bookshelf is made out of poplar wood and assembled using screws and wooden stoppers. The back of the bookshelf is lined with conductive tape to create 3 open circuits that can only be closed when the spine of a book, which is also lined with conductive tape, is placed on the shelf touching the tape. The circuits on the bookshelf are connected to an Arudino that receives a 5V digital input when the spines of the bookshelf close the circuit.

Software – The digital signals being read by the Arduino are passed along to a Processing sketch using Firmata. In Processing we developed a simple script that looks at the state of each circuit and determines the "cultural" state of the bookshelf by displaying different images on the screen depending on how many books are placed on the bookshelf. For the sake of quickly prototyping and testing our concept the "cultural" logic in our processing sketch was kept simple and the we visualized the "cultural" state to

demonstrate how the system would adjust invisibly in the backend if it had a database.

Rocket the Radio

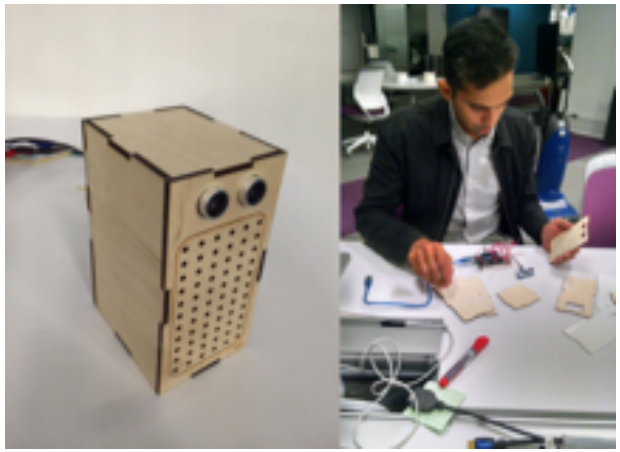


Figure 2. Completed fabrication of radio, with distance sensors concealed as 'eyes' (left), assembling fabricated parts together to conceal Arduino board (right).

Hardware
The radio is made out 1/8 in laser cut plywood with press fit joints. Inside the plywood housing is an Arduino connected to a HC-SR04 Ultrasonic Distance Sensor.

Software
The analog signals from the distance sensor read by the Arduino are passed along to Processing through the serial port. In processing we developed a script that looks at the current state of the bookshelf and gradually adjusts the song being played (using laptop speakers) from a default playlist to the "bookshelf" playlist based on the radio's proximity to bookshelf.

Nicky the Window

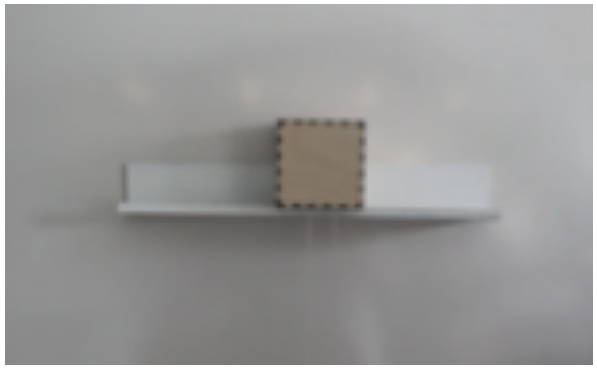


Figure 3. Control input for window using a pulley system, encased in a fabricated plywood box.

Hardware
The window is made out 1/8 in laser cut plywood with press fit joints. Inside the plywood housing is a pulley system incorporating a rotary encoder.

Software
The window displays its content through projection. It augments video of the outside world through digital manipulation of recorded or live image.

2.0 Findings

Progressively, we see the introduction of personified smart objects into heterogeneous ecosystems inflecting human behavior in a series of stages.

(1) Learning

In this phase, objects take a passive role and absorb as much information and data as possible in order to establish the context they are working in. This includes, but is not limited to, accumulating past purchases, histories of searches, etc.

(2) Performing

In this stage, objects have a pretty thorough grasp of human actors' intent, likes and preferences, and act accordingly. Through machine learning, smart objects continually collect more information in order to refine their algorithms that extrapolate taste, preferences and provide automated suggestions that are relevant. Information is exchanged between objects as a resource that can help better facilitate their tasks and inform contextual decisions.

(3) Misalignment

At this stage, objects continue talking to each other but are so self-interested in pursuing their own values that they resort to deceitful strategies to get what they want. This causes a misalignment, or even direct conflict with the goals of human actors and smart objects, which in turn creates frustrating interactions that bring little utility to human actors

3.0 Evaluation and Future Work

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Looking ahead, this initial exploration enabled us to gain a glimpse of how cascading interactions within a heterogeneous system might look like, and also highlighted several areas that are worth exploring.

First, a significant area we intend to explore further is the effect of animism and object intent on human actors have. The project, AniThings, by Phillip van Allen and McVeigh-Schultz, explores how "heterogeneous multiplicity" can evoke creativity through embodied engagement (2013). By including multiple human actors in the mix, the objects form an interesting matrix for each actor's preferences, intent and interactions to be interpreted and harnessed in multimodal outputs. The negotiation of which actor's preferences get expressed more strongly or frequently is an interesting one, with the objects acting in accordance to their own priorities.

The reception we received at an initial demo was a positive one, which reaffirms our initial belief that human actors are delighted by objects that are endowed with animistic characteristics. How this inflects their interaction and negotiation with them is also a rich area worth pursuing, especially when multiple objects start vying for attention and interaction from human actors. Will the eventual information overload discourage human actors from having these animistic objects inhabit their physical space, or does the organic interaction between objects remain attractive to users?

This initial foray into creating a heterogeneous ecosystem incorporating open-system elements also raised many questions about what a truly open

ecosystem might look like. One such issue would be the hierarchy of intents expressed - should all objects be able to interact and interrupt human actors at the same level, or are there those which might only be limited to a periphery? If so, which ones and why? Given that many of the smart object ecosystems existing now act in hermetically sealed systems, what would interactions in an open one look like?

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