Taking Things Apart: Reaching Common Ground and Shared Material Understanding

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ABSTRACT
In this note we discuss and argue about how taking things apart and disassembling can be meaningful practices in explorative design projects. In particular, we report on an explorative design exercise about taking apart an unfamiliar device. Relating to this design situation, we provide accounts for how collaborative hands-on experience can support reaching common ground and acquiring shared material understanding in an interdisciplinary design team through establishing a *material brief*. In the end we reflect and discuss how this may complement our practices regarding materials and interaction design.

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Artifacts; disassembling; exploration; material

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Moving away from the individual professional, contemporary research agendas in interactive system design bring forward concerns that are inherent to any multi-disciplinary activity: Considering design to be a constant collaborative struggle, a "(...) *communicative activity in which individuals are called upon to decipher one another's design worlds*", [7] reaching common ground and shared understanding is central. One possible – although not desirable – way to bypass that effort would be to stick to the brief, as one can "(...) *avoid dealing with design worlds and their construction only by assuming counterfactually that objects and relations are given as 'inputs' with the first presentation of a design situation."* [7] This is obviously a vain endeavor with respect to any *explorative* design process, as there might hardly be any brief providing 'inputs' that can be misread as objects and relations. While in a typical user centered scenario collaborative design efforts might start with a *client brief*, the situation in a collaborative design exploration is very different. In this paper we argue that collaboratively taking apart interactive artifacts can foster common ground and shared material understanding through establishing a *material brief*.

Figure 1: "The Thing" – an unknown device

We report on a design exercise we conducted, focused on the practice of collaboratively disassembling an unknown device. An interdisciplinary design team got confronted with the task of figuring out the purpose of a mystery interactive device (see figure 1). This unknown artifact was thus carefully taken apart, examining it both in terms of design and materials. The understandings gained from that process were then used to further explore the material qualities of the system's core component, a motion sensor.

While disassembling processes are common across a variety of individual practices, e.g., as a tool for learning in engineering, we aim to highlight their value as a shared activity in design projects. Ultimately, we want to explore related deconstructive practices and activities for design teams that go outside established constructive methods in interaction design and that have a strong focus on shared engagement with materials.

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BACKGROUND

The goal of this paper is thus not to push for a brand new method, but rather reflect on the themes and practices emerging throughout the presented design exercise. Nevertheless, we do recognize that many researchers are actively developing new methods, tools and ways of working to fuel processes like this, processes where common ground and shared material understanding would emerge between team-members working together.

One such method within the scope of HCI and interaction design is Rapid Prototyping in the area of Ubiquitous Computing [2] where the goal in part is to explicitly overcome multidisciplinary boundaries. Another example of this is the work around the Inspirational Bits method [8], where a piece of technology e.g. Bluetooth, is viewed as a material that can be explored in design sketching sessions by interaction designers. Other approaches aim to emphasize the perceptual qualities of materials [e.g., 4] or to draw lines from specific culture practices around materials [e.g., 9]. Moreover, research is not independent of what is going on in society in general, and subcultures such as maker culture, circuit bending and do-it-yourself practices have influence on our design activities.

THE DESIGN EXERCISE: TAKING "A THING" APART

We will now describe a design activity that was conducted as part of a larger research agenda, aiming to elaborate on explorations of materials in interactive systems design. This design exercise became oriented around an interactive keychain device (see Figure 1) that two of the authors literally stumbled upon in their lab. The procedure of unveiling the device's purpose was set out to be an open one and went through different stages; *getting acquainted, disassembling* and *material exploration*.

As a related concept, *reverse engineering* can be described as a process that through careful and structured disassembly unfolds and details the knowledge contained within an artifact [5]. Moreover, it is an approach used in a variety of settings and is not limited to engineering. Common teardown methods, often as part of reverse engineering processes, strive to figure out *how* some system works. [1] The end result is commonly documentation covering core functionality and any material knowledge needed to create identical copies or improvements of the artifact. Reverse engineering methodology has been found to be beneficial as a means to get engaged with problem solving and critical thinking. For instance, educators have cultivated this potential e.g., by means of designing "Deconstruction Kits" that aim to promote learning while being taken apart [3].

Although those processes might to some extend include an analysis of some appliances intended use, its functionality, feature set, etc., the given purpose of a given system is usually known before. In contrast, no additional information was available in our particular case. Driven by the lust for solving the mystery, we carefully defined guiding rules with the purpose to maintain a high level of engagement with the artifact. What can be roughly summed up as "no cheating allowed" was the commitment not to use any method that could unveil the secret immediately (e.g., through using image-based online search engines).

Getting acquainted

Initial attempts to quickly unveil the device's purpose failed, i.e. no product or vendor name was found on its enclosure, and the only recognized features were a battery compartment and a rocker switch labeled "on/off". What caught the team's attention was how the individuals in the team were to approach the materials that the thing was made of. While one of the team members, with a background in industrial design, aimed to unveil the device's purpose by reflecting on its form-factor, the other team member, a maker, tried to figure out what electronic components that might hide inside the semi-transparent plastics.

The initial step of putting in batteries and toggling the switch labeled "on/off" did not reveal much: A green LED started to flash periodically, but no further obvious action happened. The maker tried to examine whether there is any pattern to be found in the flashing of the LED, or any reaction to external influences (e.g., different light conditions, sound). Concurrently, the designer started to examine the external structure of the artifact, it's form-factor as well as the used material, aiming to decode the physical design as well as the rationale behind the inherent design decisions: shape and form, color, etc. This procedure was then complemented with brainstorming about the device's purpose.

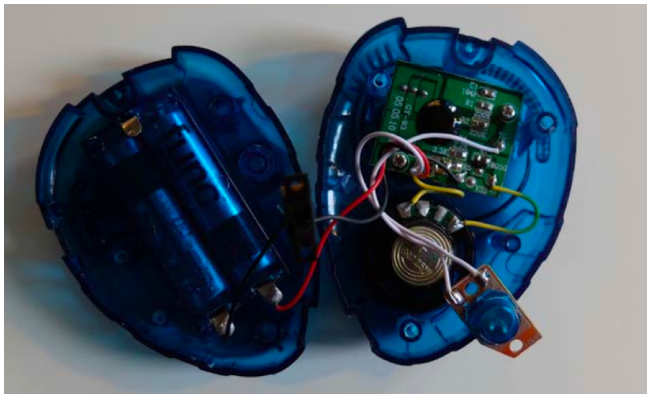

Figure 2: The disassembled device with the movement sensor hanging out in the bottom right corner.

It needs to be stressed that despite the efforts to unfold the device where driven by the two different perspectives, related activities were conducted shoulder to shoulder. Combining the various attempts to analyze the device together with brainstorming about its potential functionality, caused the team members to constantly question and challenge each other's proposed rationales. As an example, at some point the designer came up with the

idea of the device being an underwater camera. Negotiating one another's suggestions unveiled that this idea was based on mistaking a camera lens for what actually turned out to be a small loudspeaker. The purpose of this loudspeaker was uncovered when at some point - accidentally dropping the device to the floor - a noisy alarm went of, lasting for about 5 seconds. It was quickly unveiled that "shocking" the device had triggered this alarm. Through experimenting with different movements *a mutual understanding of the triggering movement pattern was developed which can be best described as "hitting the device hard."*

Disassembling

After the initial phase of familiarization, the device's enclosure was opened. The physical components were the plastic shell, battery compartment, an on/off switch, a printed circuit board, an LED, a small Speaker, and what was found to be a small movement sensor (see figure 2).

The sensor was build from a small printed-circuit with a cone-shaped plastic cover on top, encapsulating two small metal balls. From an electronic point of view the sensors functionality could be described rather simple: The pattern printed on the circuit board (PCB) was composed of two interleaved parts of the circuit, and shortening them triggered the alarm. As the metal balls only touch the board on a small portion of its surface, the circuit only got closed when both metal balls were touching each other and touching one of the PCBs sections each. What was now discovered by the team members, did not match their previous assumptions about what type of movement that would set off the alarm. *In fact, a variety of movements would trigger the sensor, not just what we previously had conceptualized as "hitting the device hard".*

Material Exploration

In a next step the device's sensor was replaced by wires with croco-clamps, allowing for tinkering with simple implementations of prototypical sensors while sticking to the original function (i.e. an audible alarm triggered by closing the circuit for a short moment). We now wanted to explore the material characteristics regarding these kinds of movement sensors. The question we asked ourselves at this point was how a sketched gesture could be captured so that one precise movement would trigger the movement sensor. The on-following sketching processes involved different kinds of sketching media: paper-based sketches, physical mockups as well as functional prototypes. Different material, ideas and experiential qualities were merged into small scale material scenarios for how electrical/physical functionality of the movement sensor was combined with different gestures (e.g., see figure 3). This exploration resulted in three functional mock-ups that – although composed of equally simple physical configuration as the original sensor – each require *a very specific movement quality to trigger a signal* (i.e. the alarm): a circular movement, a certain momentum or a specific timing.

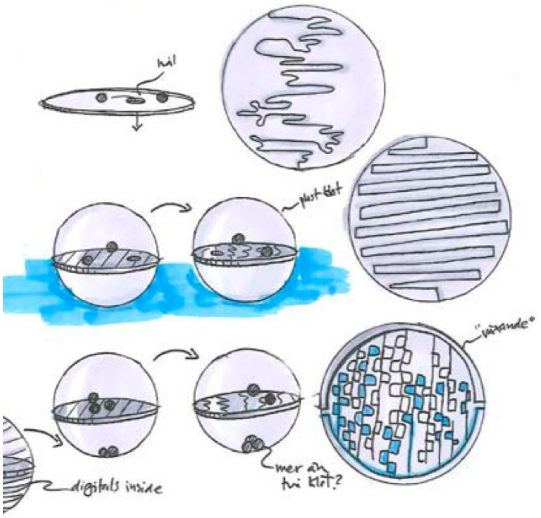

Figure 3: Design sketches exploring the interrelation between movements and the sensor's physical properties

REFLECTIONS ON THE PROCESS

Based on an exploration of the interactive use of imagination and its communicative function in architecture Keith Murphy developed the concept of "collaborative imagining".[5] He intensively examined the semiotic resources that collaborative imagination is based on, focusing in particular on talk, gestures, and material objects. In the process of taking an unknown device apart, it is those semiotic resources that unfold. We have identified several distinct occasions where there were mismatches in language, practices, assumptions and understanding. However, through the practice of working collaboratively with exploring these materials, such mismatches were bridged at the levels of language and understanding. Additionally, the resulting trove of materials became a shared resource – both in a semiotic as well as a practical sense – for the design team. In the final stage, the maker and the designer were able to use this common ground and shared material understanding for jointly exploring new directions. Through the three stages of the process, we will reflect on three main take-aways that we think would be relevant: the concepts of *common ground, a shared material knowledge, and a material brief.*

Common Ground

The first take-away is that, in line with *collaborative imagining,* this common platform is grounded in practices of working hands-on with physical materials rather than envisioned use. Thus any further exploration will arguably be built on a level of joint envisioning through practice rather than disconnected assumptions. In trying to understand the device, each of the team members utilized the media that each was fluent with. For example, when trying to understand the sensor's inner workings, the maker phrased his questions by probing the circuit, while the designer translated her presumptions of the sensors

functionality into pen-and-paper sketches. This process was characterized by the continuous negotiation of assumptions and preconceptions. It not only fostered common conceptions of the relation between the physical manifestation and functions (of e.g., the sensor), but moreover allowed for a mutual reflection on respective practices.

Shared Material Knowledge

The second take-away is about how this process of taking something apart brings out the nature of the underlying digital materials. When the design team was encountered with the physical disposition of the sensor their presumptions had to be refined. This meant that an extended conceptual framing had to be found, in order to realign any previous consensus with the new added information: the interrelation between the sensors components, its form, the very pattern on the PCB, the interrelation between this pattern and the size of the metal balls, the tapered cover, etc. In order to capture these extended framings, new notions emerged including *likelihood* (chance that the sensor would be triggered given a certain movement), *zero-position* (neutral mode of the sensor), *directionality* (only movement in a certain direction triggering the sensor), *symmetry* (form of the PCB and the steel balls), *timing,* etc. Likewise, shared metaphors, gestures, diagrams, sketches were created as part of this process. Such notions might be imprecise and even meaningless to others outside this team, but for them it became an essential part for framing their shared understanding about the material they explored.

A Material Brief

The third and final take-away is how this part of the process started as a blank slate. There were no requirements from the start other than free exploration. Later, the unidentified device would provide many of the requirements for how it was to become explored. In this case there was no real design situation in the traditional sense of having a design brief, but rather what would emerge halfway into the process was something of a *material brief*.

However, at a certain point in the exercise, when all the components had been disassembled, the functionality had been sketched out and the design had been decoded. What is still missing then is a purpose. What used to be just an unknown device had at this point transformed to hands on knowledge for handling materials, researching functionality together with form and aesthetics - on many different levels, including electrical properties, interaction qualities and elementary physics such as Newtonian mechanics and dynamics. At this point in the process, all available materials, the common ground, and shared material understanding became ready at hand and ready to begin sketching with.

CONCLUSION

In this paper we have reported on an explorative design exercise formed around an unidentified device. Based on our reflections we argue that collaborative disassembling processes can bootstrap explorative design processes at an early stage. Through the discussion we provide three main takeaways that emphasize how teams of interaction designers can develop a common ground and shared in-depth understanding of the materials involved. Furthermore, a shared *material brief* would arguably not emerge without effort but would rather be the result of joint hands-on activities. While we do not argue that the process described in this paper is replicable as it is, we hope that the presented reflections serve as a starting point for further elaboration on disassembling practices in interaction design.

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