Material Probe: Exploring Materiality of Digital Artifacts

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ABSTRACT
We present an approach for exploring materiality of digital artifacts by suggesting a study method—*material probe*. The purpose with the method is to understand how people perceive material qualities of artifacts and to discuss how designers could intentionally and methodologically include such non-functional user desires related to material qualities in the design of digital artifacts. The study procedure and results from preliminary studies are described with their implications for future work.

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Materiality, material probe, digital artifacts, design method.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
As computational technology becomes more tangible, it pervades everyday life in various forms of objects such as interactive furniture, responsive architecture, or electronic clothing. No longer constrained to a particular type of digital devices, computers now tend to be considered as *a material for interaction design* [8, 12, 14, 15]. Accordingly, exploration of materiality of computational technology is in demand in terms of how to seamlessly combine physical and digital qualities in computational materials and how to create new aesthetic qualities (i.e., affective, embodied, experiential values) of digital artifacts in designing with those materials.

However, forms and material qualities of digital artifacts have been rarely considered compared to their functionality in interaction design and Human-Computer Interaction (HCI) research [8, 9]. With too much emphasis on intangible functionality, recently the design of digital artifacts has become minimal in physical aspects and their materiality seems like disappearing by merging physical and digital design elements as in touch screen devices. These new designs have brought significant functional benefits including intuitive interaction from direct manipulation and portability from compact design. But, the qualities of rich sensory feelings from physical materials and active user engagement with them have not been fully explored in interaction design. In this study, we attempt to explore materiality of digital artifacts by questioning how well material qualities of physical artifacts are adopted to digital artifacts. The exploration first needs to be based on the understanding of how materials and materiality have been considered in traditional design disciplines and in recent interaction design and research.

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Materiality in Design
Traditionally materiality has been an essential element of design. Specifically, material selection—based on the understanding of physical properties of a variety of materials—is critical in forming aesthetic and functional qualities of an object, for instance, in architecture and product design [1, 11]. At the same time, unique symbolic meanings of a certain material—based on its social or economic values—are also something designers need to consider beyond functional qualities of a design—as in fashion design. Through the lens of materials, design can be considered as a process of creating meaning with proper materials based on exploratory practice with them. Moreover, materials are not just a given to be incorporated in designer's calculation, but are a part of design problems [4]. Invention of a new material sometimes brings design innovation and changes our experiences with objects, as seen in many examples such as plastics in modern design. The advent of new materials in the modern era often poses a new design problem—both in terms of operationalizing new manufacturing process for them and envisioning their social and cultural impact in use—rather than providing a simple solution for what design opportunity is considered.

Materiality of Digital Artifacts
Recently designers of digital artifacts are facing a particular challenge regarding design material due to its complex composition of physical and digital qualities. Especially with respect to the computational aspect of interaction design materials, Löwgren and Stolterman [12] described digital technology as *material without qualities*, indicating its unlimited yet undefined design potentials—both aesthetic and functional qualities that designers could realize with digital technology. In other words, the design

of digital artifacts is largely open, leaving designers with significant power to shape a future and also with corresponding responsibility.

There have been many technical attempts to fabricate new computational materials and to explore their applications from computer interfaces to interactive products—as in studies of transmaterial [3] and computational composite [15], to name a few. These technical explorations have brought an increasing attention to aesthetic forms and interactive behaviors of digital artifacts enabled by new computational materials—as in studies of organic user interfaces or kinetic user interfaces [9]. Based on these technical attempts, now physical and digital qualities of computational materials are not separately considered anymore, but tend to be explored more holistically with focus on aesthetic qualities of a design [14].

While technical and aesthetic potentials of computational materials are explored mainly in the context of research and development, there are also increasing attempts in art and design to expand design possibilities of digital artifacts by diversifying material selection. Similar with the approaches of fashion design, designers and artists apply authentic materials or visual patterns to decorate surfaces of digital devices. As seen from some examples of designer computer collections [5] or luxury mobile phones [16], unique material selection creates a greater emotional or expressive value within digital devices that cannot be replicated by other devices with similar functionality.

There are also experimental design projects that explore materiality of digital artifacts with new design processes. For example, Nokia personalization project manufactured mobile phones out of metal, wood, and rubber with a craft approach [13]. Designers from IDEO developed prototypes by applying physical materiality to new forms of interactive devices such as felt-covered printer or card-based music player [2]. These explorations illustrate that materiality can significantly affect how a digital device is designed and experienced beyond how it is looked or felt. At the same time, the design outcomes from these projects show promising potentials of an alternative design approach that is *inspired and driven by material explorations*, not necessarily following functional requirements.

Objectives: New Approaches for Materiality

Our study is motivated by increasing technical and aesthetic potentials of materiality of digital artifacts with questions of (1) how well material qualities of physical artifacts are adopted to digital artifacts, and (2) how to consider materiality in designing digital artifacts. Here, by digital artifact we mean existing as well as potential types of physical product that delivers digital contents through its interactive features. One of the assumptions of our approach is that materiality, as more than physical qualities of materials, can significantly affect how a digital artifact is designed and experienced. Since material selection in design is closely related to aesthetic intention of a design as well as its functional requirements, approaches for materiality require both methodological and intentional deliberation. Based on the understanding of approaches for materiality from traditional design disciplines and recent interaction design (as briefly described earlier), we attempt to investigate people's desire related to material qualities and to apply the insights to design of digital artifacts with our study of *material probe*.

OUR APPROACH: MATERIAL PROBE

We present our approach—*material probe*—that explores conceptual dimensions of materiality in interaction design. Inspired by the approach of cultural probe [7], we aim to understand how people perceive materiality qualities of artifacts and to discuss how designers could intentionally and methodologically include such non-functional user desires related to material qualities in the design of digital artifacts. Specifically, we examine materiality of artifacts by *comparing* and *contrasting* the material qualities of digital and physical artifacts. To do this, we consider artifacts as a whole, as a combination of individual design variables (i.e., shape, color, texture, historical/cultural reference) that are perceived, experienced, and interpreted holistically by a user. In this sense, artifacts are used in our study as catalysts to develop personal stories or preferences of materiality. This exploratory motivation is distinguished from other approaches that use artifacts to evaluate affective qualities of specific design variables as in [10].

Study Procedure

The study of material probe consists of three parts, where participants are asked 1) to talk about stories of physical artifacts based on their memories, 2) to play with material samples while speculating on their material preferences, and 3) to compare and contrast the material qualities of physical artifacts to their experience with digital artifacts.

1) Tell stories about material qualities

This part is to explore how people perceive, value, and articulate material qualities of objects from their memories. Followed are the questions that we asked:

- Do you have any object that you like/dislike because of its material qualities?
- Could you describe specific experiences or memories about that object and its materiality?

2) Play with material samples

In this part, a set of material samples is provided so that people develop conversation regarding material qualities of artifacts by playing with them. The samples include rubbery toy balls, plastics, wood, papers, fabric pieces, and so on by covering a certain range of different physical properties (i.e., soft, hard, shiny, warm). They are selected for an inspiring purpose instead of representing a broad range of design materials in general (Figure 1). In this part we asked:

Figure 1. Material Samples.

- From these material samples, could you select 2-3 ones that you like/dislike?
- Could you explain why you like/dislike them specifically in terms of their material qualities?

3) Compare and contrast to digital artifacts

This part is to investigate how people's desire related to material qualities are satisfied in design of digital devices. People were asked to compare and contrast their experience with digital artifacts to their preferences of material qualities discussed in previous parts. In this part we asked:

- Which digital device do you use most frequently? Please describe its features and context of use.
- Could you compare the experiential qualities of the digital device to the material qualities that you picked out as your favorable/unfavorable ones?
- Could you imagine how current digital devices would be transformed if your favorable material qualities would be incorporated into their forms?

Findings and Insights

We conducted 3 sessions of material probe studies with 15 participants, each lasting about an hour. 10 participants of two groups were graduate students who volunteered to the study in the HCI Design program at Indiana University, and 5 participants of one group were researchers who attended to the workshop on *artifacts in design* at CHI 2010. Followed are the main findings from each part of the study:

1) In the first part, participants described materiality mainly in terms of their tactile and visual perception. For example, as their favorite objects, they picked out microfiber t-shirt (because its soft texture invites touching), buttery turkey (because the feeling of organic skin makes cooking enjoyable), bubble wrap, cat (because of its silky fur), memory foam pillow (because of its squeezable and responsive shape), bear doll or blanket (because of the memory of childhood), herbal leaf (because it feels like a life that needs my care), sharp pen (that writes smooth), high-end digital camera (because of its mechanical shutter sound), desk made of stone (because of its masculine look and feel), etc. For unfavorable ones, they mentioned new towels or clothes (because of their hard and rigid textures), chalkboard (because its rough surface makes disturbing sound when scratched with nails), rubbery frame around sink at kitchen (because of its slimy, unhygienic look and feel), forks and knives (because of their metallic coldness and sound), etc. What was noticeable here is that people care about materiality in their experience with everyday artifacts and associate diverse meanings to their perception and appreciation of material qualities.

2) In the second part, playing with a set of material samples, participants talked about materiality more specifically in terms of economic values, design process, aesthetic qualities, and practical applications of certain samples. Many people picked out soft and rubbery pieces from toy balls, pieces of knits or papers with delicately crafted textures, soft cotton, and shiny and silky fabric pieces as their favorite ones. On the contrary, plastic or fake leather pieces were chosen as unfavorable because of their flat textures and cheap connotations. What was noticeable in this study is not which types of materials people liked or disliked in general, but that people are very *sensitive at perceiving subtle differences of material characteristics* and easily determine their preferences among them for a broad range of functional or aesthetic reasons.

3) In the last session, the focus shifted from physical artifacts to digital ones. At first, participants mentioned that they had never thought of digital artifacts having different forms or made of other materials than the current ones. However, by comparing and contrasting their experiences with physical and digital artifacts, they furthered conversations about their discontents and expectations in the use of digital devices. Some talked about how they care about the sound when typing a keyboard (as a feedback to the amount of their work), how they are worried about dropping their phones or making scratches on them, etc. Moreover, they suggested imaginative design concepts that merge physical material qualities to digital devices in a way to solve their problems—not just to decorate them with nice look and feel. The concepts include *a bouncy phone* that is made of soft, protective case and safe even when dropped, *a smelly phone* that generates sweat odors if used too much, *an encouraging keyboard* that gives pleasant sound and spring touch, etc.

Some general issues on forms and materials of digital artifacts were discussed as well. For example, it was mentioned that digital devices might display less social presentation in a sense that their forms do not have causal relations with their functions. Specifically, it is obvious to tell what a person is doing when s/he looks at a physical book, but not quite apparent when s/he looks at a laptop. In some contexts, such as during classes or lectures, this could be a problem if students use their laptops for other purposes (i.e., chatting, browsing websites) insisting that they are taking

notes. Again, this reveals that materiality of digital artifacts is deeply related to other dimensions of user experience beyond look and feel of digital devices, and can significantly affect our social experience as well. At the same time, recent design efforts to simulate materiality of physical objects within digital devices were discussed—for example, by making wooden cover of mobile phones or by emulating mechanical shutter sound of digital cameras. The issues discussed in this study provide insightful design implications to be further investigated—not by informing how to satisfy people's subjective preferences to diverse material qualities, but by revealing that *people care about experiential qualities of materiality that might be lost or obtained in using digital devices.*

DISCUSSION AND IMPLICATIONS

In our preliminary study of material probe, it was clear that people do perceive the materiality of artifacts critically and that there is a gap between how they experience physical and digital artifacts in terms of their material qualities. Our approach here showed its potential in provoking interesting design concepts by adopting physical material qualities to interaction and functional aspects of digital devices beyond decorative purposes. The results imply that designers of digital artifacts need to consider materiality as playing a significant role in user experience [14].

Based on the specific findings and insights from the study, some tentative design implications can be suggested in terms of how to consider materiality in designing digital artifacts, namely *material simulation*, *material expression*, and *material exploration*. *Material simulation* is to emulate sensorial feelings of physical materiality within digital artifacts, as seen in graphical effects of turning pages in e-books or sound effects of shutter press in digital cameras. *Material expression* is to create more visible, physical forms of digital artifacts for expressing affordance or social presence of interaction. *Material exploration* is to create new types of forms or functions of digital artifacts by considering materiality at an early phase of design (instead of representing functional requirements or simulating physical materiality at a surface level). The concepts of rubbery phone or smelly phone discussed in the study can be examples of the approach of material exploration. We expect that these tentative implications can initiate further methodological explorations regarding how to consider materiality in designing digital artifacts.

We also saw some limitations of our approach; user responses tended to be influenced by the group discussions and the actual selection of the material samples prepared for the study. For instance, many participants commented that most of material samples reminded them of toys, which are fun to play but hard to apply for broader contexts or purposes of use. It was also mentioned that participants' responses regarding their material preferences maybe very spontaneous as well as subjective. This means that the study cannot be applied to make design decisions for material selection as a rigorous method. Instead, its contribution lies on initiating a conversation regarding material qualities of digital artifacts as a methodological attempt. In our future study, we plan to develop this exploratory study into a valid design method by complementing those limitations.

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