Tangible Disparity - Different Notions of the Material as Catalyst of Interdisciplinary Communication

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Abstract. Communicating tangible technology designs hinges on an adequate notion of materiality. However, academic disciplines involved employ wildly differing notions of the material. This issue effects communicative boundaries within interdisciplinary teams tasked with development of tangible digital artefacts. In order to address this problem, we provide an analysis of differing disciplinary modes of conceptualisation and theorisation. Following these considerations, we discuss theoretical artefacts able to serve as communicative interfaces between the disciplines in question.

Keywords: materiality, interdisciplinarity, cultural informatics, critical technical practice.

1 Introduction

Any meaningful deployment of tangible technology finds itself embedded into a heterogeneous array of materials and social practices. While production of physical artefacts calls for practitioners versed in design or possessing skills as artisans, the digital side of tangible technology production usually is addressed by computer professionals. Inevitably tangible technology production takes places in interdisciplinary networks, while each discipline possesses its own theories, intellectual heritage and modes of problem solving.

Recently, the notion of materiality has gained special attention within the community of interaction design [13,1]. Within the field of cultural studies interest in materiality of artefacts has reached a level where scholars proclaim a "material turn"[6]. While different scientific and intellectual trajectories are at work here, tangible interaction projects have to account for these academic developments in order to make use of the intellectual artefacts produced.

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2 Different Materialities

Most often the term 'tangible' is used in a literal way within tangible interaction projects, denoting artefacts one can touch with one's hand, exhibiting haptic qualities.

While dealing with this type of materiality does not seem to pose greater problems for engineers, accustomed to dealing with artefacts anchored within the realm of the physical, the same cannot be said for computer-scientists. The main mode of production for the computer scientist is the production of source code or other formal or semi-formal types of communication. Floyd describes software as consisting of 'a uniform, abstract building material [. . .] not amenable to sensory perception' [3]. Consequently, those educated mainly in computer science do not find themselves equipped with rich vocabularies for dealing with the tangible or with sensory phenomena in general. At the same time what computer professionals are dealing with, code, exhibits some qualities of a material, rendering it comparable to building materials occuring in disciplines such as architecture.

Accordingly, we found the concept of digital materiality to constitute an ample conceptual bridge, allowing for notions and communications to be translated between researchers and practitioners. Leonardi provides a comprehensive discussion of digital materialities within the context of organisation theory [10].

Furthermore, conceptual integration between computer science and social science already has been achieved by virtue of Paul Dourish's stance of Embodied Interaction (EI) [2]. What embodied interaction achieves is to provide a cogent argumentation for a common conceptual model, encompassing both social as well as tangible computing. Both have to be understood on the basis of situated social actions, in both cases meaning must be conceptualised as being essentially context-bound. EI however does neither want to provide a wealth of concrete design guidelines, furthermore it does not account for the theory-making processes accompanying the practice of software construction. In consequence, we believe it worthwhile to embrace the conceptual devices introduced by EI, while complementing it with theorisations of the material as outlined above.

3 Past Discussions

In the following, we will retrace the discussion process within the HCI community.

Jung and Stolterman [7] employ the classical distinction between material and form. They provide an in depth discussion on the relationship between digital form and materiality. Explicitly aimed at introducing perspectives from disciplines like art, design, social science and humanities they try to reconceptualise key concepts within HCI discourse. They propose a new approach towards development of interactive artefacts dubbed *form-driven interaction design*. Within the digital materiality discourse they hereby claim that construals of the digital as material can be brought to fruition. A key metaphor introduced is that of *material ecologies* aligning itself with discourse on the topic of design and interface ecologies [8,9,5].

In his seminal articles [10,11] Leonardi analyses the problem of material from the perspective of organisational theory. Leonardi gives a semantic analysis centered on language use within legal and institutional domains. He first examines the predicate 'material' within the domain of law. Material evidence is that which pertains to the matters at hand, to the current case, to inquiries that 'matter'. Material provides substance and enforces restrictions. In doing so, the text does not try to extract a unified semantic kernel. Leonardi's efforts center on the question of explaining how digital artefacts can make a difference. In the course of his discussion Leonardi does not lose the distinction material/formal. He does however relegate it to the position of a single dichotomy within a broader conceptual ensemble.

Positions like this explicitly or implicitly relate to positions within the history of ideas. Form/Material is a very old distinction in the history of thought, reaching back to the times of antiquity. Aristotle provides for an analysis of the conceptual division between hyle and morphe. The form being the organising principle, hyle denotes that which is being formed. He applies these categories recursively: Aristotle's thought still remains to be extremely influential. For example categories like such as shape reappear in Jung and Stolterman's text [7] while there is no explicit mention of Aristotle.

What generally tends to be repressed is Aristotle's theory of causation. Not many authors talk of *material causes* though this could constitute an interesting candidate for introduction into the digital materiality discourse.

Leibniz is one of the first authors dealing explicitly with the digital. However, his monadic perspective differs fundamentally from modern conceptions of the material. His position is special, for it marks a radicalisation of Aristotle's conception of the world as a *teleological* structure. There is no 'pure' or 'empty' material for Leibniz, everything is causally integrated. Furthermore, substances represent the wholeness of the world, however imperfectly. While remaining important as thinker of the digital, Leibniz' positions are notoriously hard to incorporate into contemporary discourse of the material. This, of course, ensures his role as potential conceptual irritant. His theories are extremely well structured and formal themselves, appealing to formal scientists' aesthetics.

There is a vast array of literature on the problem of material within the domain of *architecture*. Truth to materials being an ideal of modernist architecture.

Vallgaarda and Redström [14] argue that digital material is not substance. They thus criticise notions of the digital as material as brought forth by Jung and Stolterman [7]. For Vallgaarda and Redström the digital needs to be combined with other elements in order to become material. They thus argue for conceptualising interactive artefacts as being made of a *composite material*. Only when the digital is combined with non-digital material is it able to make a difference. It does not possess substance of its own, nor is it a structuring principle opposed to mere material. By doing so, Vallgaarda and Redström sidestep the implicit judgements of value often attached to distinctions such as form/material. The digital is not seen as more 'pure', instead it is part of a composite. Thus both sides are described by language evoking conceptions of physical material. Neither

is there pure material, nor are there pure forms. The authors try to transcend what is perceived as functionalistic restriction within HCI discourses. The approaches they formulate do not revolve around questions of function. Instead they can be construed as evolving relationships between materials.

Loos invokes the material in his seminal essay "Ornament and Crime" [12]. Ornament is seen as a device causing objects 'to go out of style', while their functionality remains intact. It can thus be read in context with contemporary discussions on digital obsolescence as well as the general planned obsolescence discourse.

4 Functions

As seen, invoking the concept of the material can serve a wide array of purposes within interdisciplinary discourse. Analysing the Invoking the concept of material can serve purposes of:

- allowing for new ways of conceptualising systems incorporating both physical and digital material
- contribute towards clarifications of differences in perspective within interdisciplinary design settings
- provide conceptual bridges towards discourse in other disciplines e.g. architecture

5 Application

In order to demonstrate the utility of concepts discussed, we will briefly outline a set of prototypical design artefacts. Their creation process was informed by the theoretical interfaces covered. They are situated within the domain of museum and exhibition contexts.

5.1 Project Context

Observations made as well as concrete discussions conducted took place within the interdisciplinary research training group crossWorlds. Situated within an academic context, researchers with backgrounds in engineering, computer-science, philosophy, cultural theory, design, sociology, media psychology, rhetoric and neuroscience all contributed to the project.

5.2 Requirements

Informed by the notions discussed, the following requirements drove the prototyping process:

- Installations should feature the materiality of the exhibits, not distract from them by providing additional gadgets.
- Installations should facilitate direct social interaction. They should not mesmerise users by capturing their attention within spectacular technological displays.

5.3 Dimensions of Materiality

Within the interface ecology outlined, we deal with different types of materials. These relate to and affect each other throughout the whole setting:

physical materials At first there are historical materials, the exhibits, the objects of interest, whose materiality should be featured. On the other hand there are contemporary materials, which have to align themselves with design requirements. They form the material basis of interaction artefacts such as cards, displays, stamps, smart phones, etc. . Their material characteristics are crucial with respect to interaction processes. Human bodies have also to be considered as physical materials that allow for and constrain interaction due to their material characteristics.

social materials - peoples minds, their comprehension of the world - social and cultural contexts

digital materials could be representations of information about the object of interest, in the form of texts, pictures, videos or structures. Another digital artefact to be considered is software, as an element structuring the interaction process and presentation of information.

5.4 Prototypes

Following the requirements given, we outline two of the prototypes developed, describing how they relate to theories presented:

An *interactive table* installation was developed, allowing visitors to collaboratively access exhibit related information 1. Instead of using digital representations within a traditional multi-touch layout, actual exhibits or physical reproductions are employed as *tangibles*. Placed on the table surface, they act as proxies into the underlying information space, allowing for interactions to be triggered. Thus, the turn towards materiality is reflected within the design artefact produced. Whenever possible, direct tangible interactions with exhibits are employed instead of having users deal with digital representations. In order to remain true to historical materialities, touching actual exhibits is infeasible, reproductions should mimic the original's sensual qualities as closely as possible.

A recommender system is used to guide visitors within the museum space. It embodies the idea that digital material ought to be used to equip other entities with affordances. In its concrete form, it is constructed as a *social recommender* (such as described in [4]) supposed to facilitate direct face-to-face interactions among visitors. The historical materiality of the exhibits is embedded into modes of interaction inherently contemporary. Touching and interacting with exhibits and reproductions triggers events which are part of an UI-design inspired by social networking websites.

6 Discussion

New physical materials are introduced into HCI oriented making practices, causing an increased level of interest in questions of materiality. There has not yet

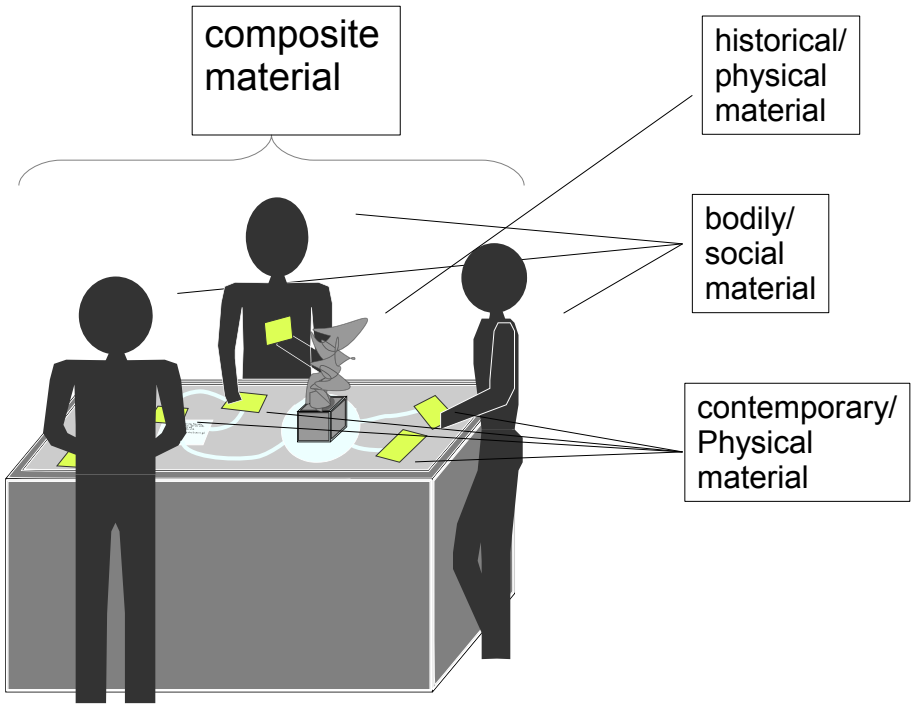

Fig. 1. Dimensions of the material with respect to tangible user interfaces

been convergence either between disciplines or within the field of HCI regarding conceptions of digital material. What can be observed however, are new waves of interest in questions regarding materials.

The proposed set of installations presents a blend of contemporary and historical materials. The former are employed in order to highlight the qualities of the latter. They were produced in an interdisciplinary context, paying special attention to differing conceptualisations of the material.

It was shown how the notion of materiality can be employed as a conceptual lens for providing fresh perspectives on interdisciplinary technology design. Tangible technology production calls for highly interdisciplinary design processes. Within these communicative problems can arise regarding different modes of conceptualising the material. At the same time, there are points of convergence in the form of a common "material-turn" among the disciplines. Possible conceptual interfaces were discussed with a focus on the notion of digital materialities. The discussion provided delineates a starting point for exploring these concepts within design contexts.

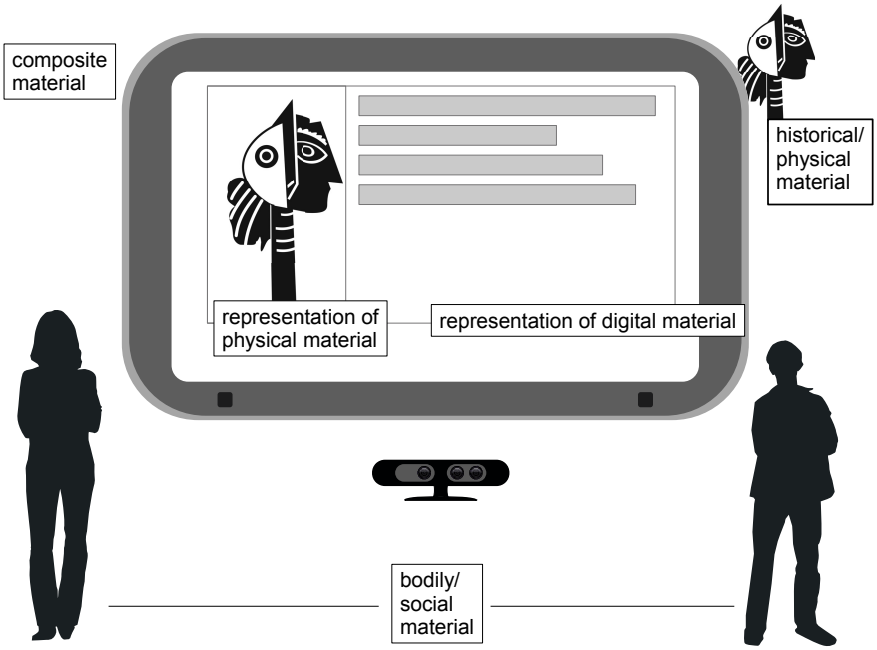

Fig. 2. Different dimensions of the material with respect to a wall-mounted display

Within project contexts, discussions focussing on the notion of the material can further awareness of the conditions of interdisciplinary cooperation. Within these discussion processes different notions of the material designate different disciplinary perspectives.

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