Radical Clashes: What Tangible Interaction is Made Of

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ABSTRACT
Driven by a critique of Ishii et al’s recent vision of Radical Atoms we call for a debate on the different conceptual paradigms underlying the TEI community and its activities. TEI was initiated to share and connect different perspectives, but we feel conceptual debate is lacking. To fuel this debate, we start with comparing two paradigms by examining the Radical Atoms proposal and balance it from our design-led perspective. Our aim with this paper is to revive the richness of TEI’s multidisciplinary approach.

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Design, Theory, Human Factors

INTRODUCTION
This article is not an ordinary academic conference publication. It is a call for a plenary debate within the community of tangible, embodied and embodied interaction (TEI) on what we see is a (perhaps unintentionally) avoided issue: how to deal with the large differences in conceptual paradigms and core values that make up TEI?

Our interest in this question was triggered, amongst other things, by Ishii et al’s recently presented vision of Radical Atoms (RA) \cite{1}. We highly value the work of Ishii and his team, and we recognize its importance for TEI. Yet we do not share the enthusiasm, nor the underlying values implicitly put forward in Ishii’s vision of RA. What seems desirable, exciting and promising for Ishii and his colleagues, feels partly inconsiderate and shortsighted from our own, human-centered, design-based perspective. We recognize this clash of perspectives is worth further examination and attention.

The TEI community, with the TEI conference series as its main communication platform, was originally founded to bring together different viewpoints so that we can share different perspectives and a common understanding can emerge \cite{2}. This being said, actively sharing, contrasting and connecting perspectives is easier said than done, especially once a new field starts to mature. Where does today’s TEI stand in the clash or enrichment of paradigms? Are some approaches implicitly dominating the field? Are we truly aware of the large variety of frameworks? Looking at work presented at TEI since its inception, its hybrid nature stands out. But over the years, especially looking at how work gets conceptualized, we miss explicit discussion of diversity. We see few attempts to reflect, criticize, and engage actively across different paradigms.

In this article, we wish to draw attention to the fundamental differences that exist between disciplines and paradigms, recognizing how all of these frames may affect, tint and flavor TEI-related work. We strongly believe that a multiplicity of perspectives is highly desirable. What we call for is a debate on how we can ensure that both the commonalities as well as the tensions between the various perspectives in TEI are kept alive and actively discussed, and how we may avoid too much homogeneity.

Surfacing these differences and creating a shared understanding of them is not easy. It can only be done within the subtleties of an ongoing debate, reaching beyond written media. We use our space here to address one ‘radical clash’, between Ishii’s RA and our own vision \cite{3, 4, 5}. We could have discussed other clashes. Yet as RA most strongly triggered our initial reaction, we decided to use it to open the debate. Even if some readers might not fully agree with our discussion and argumentation, we at least hope our contribution helps to generate a lively and ongoing debate within the TEI community, with the overall aim of preserving or even reviving the full richness of its multidisciplinary nature.

RADICAL ATOMS
Ishii et al. recently presented a futuristic vision of human-system interaction they call Radical Atoms \cite{1}:
“Radical Atoms takes a leap beyond tangible interfaces by assuming a hypothetical generation of materials that can change form and appearance dynamically, so they are as reconfigurable as pixels on a screen. [RA] is a vision for the future of human-material interactions, in which all digital information has physical manifestation so that we can interact with it.” (p. 38, the emphasis in italic is ours)

With RA, and previously with Tangible Bits [6,7] Ishii bridges the technological and the human, the digital and the physical, motivated by hi-tech innovations that may become reality in the near future. This perspective develops technical solutions prior to elaborating how this might be usable and useful for us. In its approach and substance, RA presents a major difference to our perspective.

RADICAL PARADIGM CLASHES

Ishii’s views are representative of what we loosely call a computer science and engineering-based way of thinking. From this point of view, a professional (engineer, researcher, etc) seeks new technological solutions for human problems. Within that context the main focus is on the properties and qualities of technological innovation itself: what can we do with the technology? RA combines digital processing and nanotechnology and then presents this as a new opportunity for solving problems. As designers, instead, the central question we are confronted with is drastically different: our main challenge is to orchestrate social, human and technological resources towards a best fit-for-purpose intervention (≠ solution) in a real-world context. Our main focus is first and foremost on human values and practices. At this point the reader may object that these are just two sides of the same coin. We could not agree more! But let us discuss that coin. And let us see what the coin is made of and what it buys us.

What Tangible Interaction is made of

The common perspective of TEI, generally accepted across disciplines, hinges on the foundational idea that tangible forms, i.e. aspects of technological systems that can be physically manipulated by the human body, are in some sense special, or interesting, or important, or even crucial. It posits that tangible forms of interaction have their own particular quality over and above traditional text-based or graphical forms, when designing for interaction between people and technological systems [8]. By acknowledging the value of embodied interaction [10,9], TEI has shown repeatedly how people may gain control over technological systems not just by means of the more ‘cognitive’ route of perceiving, remembering, understanding and deciding how the system is to be used, but also by means of a more intuitive, embodied form of interaction where constructs like exploration, improvisation, learning-by-doing, personal experience, affect, constraints, affordances and couplings, play a leading role [8,9,10,11,12, 13].

Even though a shift towards embodied interaction is generally agreed upon, there are considerable differences in how these ideas are manifested in terms of design, realization and implementation. Again, each of the concrete interpretations offered is rooted in the different conceptual backgrounds which, if only implicitly, will frame that particular interpretation in certain ways. For example, is it really about tangibility or is it more the embodiment that matters? And what do these terms mean exactly? Can projections on a screen be ‘tangible’ under some interpretation, or is the term reserved for physical objects? What do we mean with a ‘physical object’ (e.g., the so-called ‘tangibles’), if we look more closely into the analysis of what makes something to be an object for us in the first place, as is discussed in the phenomenological literature [11]? And if we consider the way all kinds of forms may be appropriated in ways completely unanticipated by designers, is it not then really the social situatedness of these tangible objects, how tools are embedded in a certain practice, rather than their physical form, that makes all the difference [13]? In light of these different ways of thinking, Ishii’s vision seems to present just one of the possible interpretations of the tangibility proposition. This is in fact the view in which: a tangible object comes to be primarily an external representation of a digitally stored piece of information, and physical manipulation of such ‘tangibles’ represent digital operations (i.e. computations) on these digital bits. Or, as Ishii himself defines it: “The key idea of TUIs is to give physical forms to digital information. The physical forms serve as both representations and controls for their digital counterparts.” [6, p. xvi].

Indeed, in the most recent RA vision, this computational perspective is taken to the extreme. Here, potentially all of the physical world will come to function as part of a TUI interface to digital information. This stance is motivated by what is taken to be a limitation of the physical world:

“Unlike with pixels on screens, it is difficult to change the form, position, or properties (e.g., color, size, stiffness) of physical objects in real time. This constraint can make the physical state of TUIs inconsistent with underlying digital models.” [1, p. 40]

In response, RA offers a vision based on “a hypothetical, extremely malleable, and dynamic physical material” [1, p. 45] which is ‘computationally transformable and reconfigurable’. With this material, Ishii et al aim to “bidirectionally [couple the physical world to] an underlying digital model (bits) so that dynamic changes of the physical form can be reflected in the digital states in real time, and vice-versa” [1, p. 45]. In contrast, motivated by our own core design values, we feel very much uncomfortable with a vision in which the whole world becomes an interface to the digital. In what follows, we offer a critique of Ishii with the overall aim to show there are other ways of looking at the relations between physical, social and digital processes than just this computer-science and engineering perspective.

What Tangible Interaction buys us

Our critique of the RA vision is organized in three sections: practical issues, theoretical issues and ethical issues.


1. Practical issues

Even if we acknowledge Ishii’s vision to be a viable direction to pursue, we see tremendous problems in how to make it work in practice. We are not talking about the technological challenges, we simply assume that such extremely malleable computationally controlled materials will come to be, and for the moment we will not even consider the requirements for actually keeping such systems operational (i.e. the ecological footprint, the demands for the robustness, stability and state-maintaining capabilities without power or energy). Even then, the question remains: what to do with it? Ishii, driven by his technological, computational frame, mainly considers the technological challenges (how to map digital state to physical form, once we would know what mapping to make), but he does not answer the design question: what mappings should there be, and why? He in fact asks (but does not answer) the question when he states:

“In order to interact with the interface, the user has to be continuously informed about the state the interface is in ... An open interaction design question remains: How do we design for dynamic affordances?” [1, p. 47]

As our background is in ecological theory and phenomenology, we think the concept of affordances is indeed relevant here. But affordances [12] are not ‘information about’ as Ishii states [1]. Affordances cannot simply be ‘designed’ as a mapping of (digital) meaning to (physical) form [1]: affordances are grounded in evolved practices by means of which a person’s embodiment becomes coupled to the ecological niche [11]. A world full of radical atoms seems to suggest that we as designers will have to determine the nature of these dynamic ecological couplings. Even trying this would quickly lead to a combinatorial explosion of options, given the massive parallel interactions and dynamics involved in the coupling to their environments in situated ways in actual contexts. Alternatively, how is it precisely that Ishii would create RA as a part of some overall embodied activity, the greater part of which is not designed, i.e. not part of the RA system? Yes, we can imagine ‘interactive clay’ as a useful design-tool, affording new kinds of explorations and tinkering. But as end-product, the whole idea can become quite impractical. While RA promises to leap out persuasively into everyday life, how this technology may actually support desirable experiences, to our personal and social values, is not addressed at all in [1].

2. Theoretical issues

The previous discussion already hints at the fact that we do not see why this total collapse of the digital and physical is even necessary, as many aspects of our world function very well without digital computation. Many TEI-related works relate to Gibson’s ecological perception [12] and his concept of affordance, and phenomenology, which forms the basis for concepts of embodiment and embodied interaction [11, 10]. In these and related theories, focus is first and foremost on the value of embodied interaction for its own sake: there is a value in interacting with the physical and social environment, and this value need not be replaced by couplings to digital information. Perhaps some aspects of the tangible object itself, contextual elements, or certain bodily skills of the user, already leverage meaningful interactive activity that cannot be, nor does it need to be, understood in terms of how this maps to digital states. From our perspective, the essence of tangible interaction design is not just to give physical form to digital state. Instead, the objective may also be to design new roles for digital processes as an element in the larger process of meaning generation, sustained by the embodied engagements of a person with her social and physical environment at large. The question, in our view, is: what can digital computing do for and add to embodied interaction, instead of, in Ishii’s view: how can embodied interaction be recruited in service of digital computation? In this regard Klemmer et al state:

“Clearly, the digital world can provide advantages. To temper that, we argue that because there is so much benefit in the physical world, we should take great care before unreflectively replacing it. More precisely, from a design perspective, solutions that carefully integrate the physical and digital worlds — leaving the physical world alone to the extent possible — are likely to be more successful by admitting the improvisations of practice that the physical world offers." [9, p.8]

Tangible interaction may therefore not just be a new kind of linking to digital information, but also ask us to find new ways of integrating digital computing meaningfully into our lives, perhaps even by giving it less of a role to play than is now the case [9,13].

3. Ethical issues

When one proposes a new design vision, one by definition addresses a certain set of human values. Talking about design means talking about values, which means talk about people’s beliefs and desires. In the RA proposal, it is not explained which human values are being questioned or endorsed. In other words, what underlying value system is actually addressed? We can only guess at what we would find from the authors. But in any case, we notice several possible ethical issues that need to be discussed carefully, before we can safely go on to start building RA. For example: who is going to define all these new mappings: the manufacturer, the designer, the user, a group of users? Who is going to be in charge? What power relations will be driving this process? Will users be in (lack of) control over their environment in the same way as they are now? Referring to the online world, we see both movements of personalization and appropriation, as well as massive influence of large companies and industries. There is a continuing debate on the evolution of online presence and what makes for a desirable, humane online environment, which is both socially relevant and personally respectful. Do we have a substantive debate on these same questions regarding TEI? Will a RA future turn out for the better, in terms of freedom of choice, individual power, and so on, or
for the worse, assuming it will create an ubiquitous, omnipresent technology, invading virtually every physical aspect of our surroundings, always, everywhere? We do not know the answer, but we do ask for a discussion about it.

POINTS OF DEPARTURE
We presented three possible lines of discussion of RA, one practical, one theoretical, and one ethical. RA is a vision centered on augmenting the digital with physical properties in order to enlarge the impact digital computation may have. Our own perspective, in contrast, draws the belief that main issues concerning the physical/digital interplay are design related and not technologically driven, i.e. they pertain to the question of how interactive systems can be given a meaningful role within people’s lives. Ishii’s team works primarily from the technological, computational perspective, arguing on the basis of that starting point. We hold that the world is utterly complex and rich and that meaning is to be found in how people relate in embodied ways to their physical and social environment, and start from there. From our perspective, the consequences of RA should be articulated with far more depth in terms of human embodiment, human value, and potential for appropriation in everyday practices.

Let us stress we do not hold that our vision is the better one. The question is not what particular perspective to take. Our concern is rather: is TEI still the lively platform of diversity, in which complex issues are approached from a rich variety of perspectives at the same time?

Our design perspective is also not to be equated with that of ‘the artist’, or the ‘social ethnographer’. We appreciate all perspectives, including computational thinking—even though we criticized some of its assumptions today. Yet we can only harvest the value of multidisciplinary work if we actively keep discussing connections and tensions between them. As we feel it, such a debate, where radical clashes between conflicting paradigms are used as the very basis for forming new insight, has been somewhat lacking in recent years.

CONCLUSION
Overall, lively opinions, comments and discussions with colleagues confirm there are many ‘radical clashes’ within TEI, which is all the better, as radical clashes is precisely what TEI is made of. But instead of ignoring them, or believing they are not so radical, or choosing just one, we should get more precise about them and nourish them in open debate, with mutual respect. It would indeed be disappointing, if Ishii’s new vision would be accepted as just another ‘cool new technology’. This would cover up the fact that RA clashes radically with some values, also held in TEI. We therefore wish to foster a discussion on what these radical clashes are, and how we can better understand them, adding ever more color to TEI’s conceptual palette.

REFERENCES