A Short Architectural History of Human Building Interaction

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Abstract
This position paper seeks to locate human building interaction in the historical trends of both the development of human computer interaction and Architectural theory. This paper projects that developments such as Human Building Interaction are logical extensions of previous developments in areas, which suggests that both fields are moving towards the same inevitable conclusion: a fusion of Architecture and Spatial based Interactive Computation.

Author Keywords
Architecture; Interaction; Human Building Interaction.

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

Introduction
From the purview of human computer interaction, the notion of human building interaction gives the appearance of being on the periphery of (Human Computer Interaction) HCI research. This paper would argue, from an Architectural perspective, there is a long history of digital interaction interventions into the built form that would suggest that Human Building Interaction is in fact at the very core of historic developments in HCI and Architecture. From this

viewpoint, this paper is an attempt to expand on some of the previous work leading to human building interaction and how this might relate and inform future work in the field of human building interaction.

Human building interaction

While the history of computing is given in disembodied notions, such as algorithms and abstract computation, it could be a distraction to consider digital technologies as totally a-spatial. Architecture frequently articulates it's process and end points not with physical form, but with the notion of space[7] and the separation between elements. We may describe a pleasant room as 'spacious'. With the introduction of command line interfaces, the spaces between words had as much semantic importance as the words themselves. Early formative work in HCI such as Fitts' law[10] becomes important due to the separation of elements. With the rise of virtual reality (VR), it was observed that space becomes part of the organizing elements for computing interfaces. Weiser's vision of computing[21][22] reinterpreted the simplifying nature of three dimensional VR interfaces and re-engineered them for the real world.

In the late 1990s, Ishii and Ulmer [9] envisioned the transformation of architectural surfaces into active interfaces, fusing the physical and digital realm. The growth of research into 'Smart Homes' [3] at the turn of the millennium extended this work to show computation in action in more domestic inhabited settings. More recently, context aware computing brings forward the role of place and space in mobile computing. The role of the (typically urban) environment in relation to spatial context is beginning to be factored into the design of interactions [4].

Lately, the role of urban design and the role of digital technology has been brought to the research agenda by the rise of the 'Smart Cities' movement[2][18].

Thus, the notion of ubiquitous computing is that of computing in the environment. Human Building interfaces are then a direct linage to the growth of human computer interaction – making them the logical development of previous HIC research.

HBI and Architecture

As this paper has alluded to, it would be simplistic to view human building interaction as a concept without roots in history. What makes this topic so interesting is that there is a second stream in architecture which appears to be on a collision course with human building interaction.

Looking from the past of architecture, there have been numerous attempts to merge electronics and computation with physical architectural form.

The history of fusing digital, electronic and responsive elements reaches back to the 1960s avant-garde architectural group Archigram with elements like walking cybernetic cities and pods [17].

In the 1970s, then-Architect, Nicholas Negroponte, published Soft Architecture Machines[14] and Architecture Machines [13] about the ideas of fusing the possibilities of computation with Architecture.

In the 1980s and 1990s, Architectural and Computing pioneer, John Frazer, pre-empted many developments in tangible interaction and digital inhabitation[5]. Later, Architect, Neil Spiller, published a set of Architectural

monographs about the results of running a unit at the Bartlett School of Architecture looking at incorporating digital elements in to the fabric of buildings[20] [19].

At the same time, Bill Mitchell, then teaching architecture and media arts at MIT, wrote more about the theoretical image of digital technology on architecture and urban thinking in "City of Bits: Space, Place, and the Infobahn" (On Architecture)[12] in 1996 as a way of alerting the architectural community to the changes digital interaction would bring to the fabric of the city.

In 2006, Architect Rem Koolhaas and OMA / AMO, working on New York's Prada Epicenter flag ship story, created a number of interactive products including a series of digital 'mirrors' which captured retail customers in motion. Thus, showing that at a deep and practical level, architects and spatial designers are already incorporating interactive digital elements into the spatial function of their buildings.

This neatly sets the ground for Malcolm McCullough's book, *Digital Ground*[11], which offers an account of the intersections of interaction design and architecture. This suggests that the ubiquitous technology does not remove the human need for place.

More recently, in 2008, Architects ART+COM have designed a museum for BMW using complex projections and ambient displays building a wealth of practical knowledge[1] and fusing the virtual with the physical. *Hyposurface* by Mark Goulthorpe, *Blur Building* by Diller Scofidio & Renfro, and *Bubbles* by Michael Fox, Kas Oosterhuis and Ilona Lénárd have used digital projectors and moving surfaces to create complex adaptive spaces [16] from which much may be learnt by the HCI community.

More recently, Mikael Wiberg of Umeå University has made several contributions including the 2011 book, *Interactive Textures for Architecture and Landscaping: Digital Elements and Technologies* [23].Wiberg developed the notions of 'Architectural Informatics'[24], specifically seeking how to better integrate our built environment and digital world.

The works presented above are like those of the work developed in human computer interaction, a small curated sample of the developments and publications in this area. If we were to expand architecture to also include robotic Architecture[6], or any of the ways that architecture has engaged creatively in computer aided architectural design, then we might lose sight of the similarities between these developments and those in the mirror of HCI

Interaction, Architecture and Space

From this perspective, Human building interaction is already being approached from the field of architecture. Digital Interaction has also recognized that Architecture has a number of overlapping skill sets that may be exploited by the HCI community. In Ingram's article, *Learning from Architecture[*8], Ingram highlights that HCI can learn from the deep historical precedence that architecture brings to the process of design as well.

Conclusions

Early computers occupied rooms, and even floors of buildings. While computers became smaller, they were often associated with places, even these days of cloud

computing data 'centers' are specially designed and cooled locations. This might be felt to be a technical necessity, but as Nerdalize eRadiator[15] shows, computation servers could be distributed as radiators in people's houses. This would avoid huge power and cooling requirements while reversing the power wasted and reducing any potential security threat by distribution. From this perspective, large compute centers are a statement rather than an engineering necessity.

The creation of buildings such as the Apple Headquarters, the new Google HQ in London, and even the beautifully designed, award-winning Skype Technologies S.A.R.L Headquarters suggests that while many computing organizations see work as more distributed and mobile, they are themselves returning to the use of single centralized buildings as primary modes of production. Thus, the notion that digital companies seek the elimination of the physical for the purely virtual is a miss judgement. Space, co-inhabitance, occupation and habitation are still very much alive in the future of fully digitally enabled cities. It should be clear, therefore, we should not see the digital and spatial as dichotomies or a schism to be crossed but as a continuum, each exploiting the affordances of the other.

This workshop position paper has hoped to make clear human building interaction is not a singular reinterpretation of a branch of computing, but in many ways, the logical extension of a continuing trend in HCI is set to intersect with a similar theoretic and practical trends emerging from Architecture. From this, there can be little doubt that Human building interaction is at the beginning of a complex, evolving trend and in many ways, far from being the periphery, is in fact at the core of the developments in both human computer interaction and Architecture.

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