Ageing bodies and the space they call home

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ABSTRACT
Within the population of 'older adults' there is more diversity than in any other user group. Yet, generalised assumptions still exist about their capabilities, needs, and technology use. This paper briefly outlines existing research into designing technology for (older) users and suggests that the built environment can, and should, serve as the canvas for new technologies that support the sociophysical interactions of ageing bodies. Innovations coming from the fields of tangible interaction and interactive architecture have the opportunity to consider the whole environment in which such bodies reside. Rather than devising specific technologies for older users, this paper suggests focusing on the incorporation of flexible, mainstream technologies, into adaptable, intelligent homes, which support the autonomy of older adults. The challenges of such an endeavour are discussed as the grounding for future research into sociophysical technology that supports older users.

Author Keywords
older users, ageing bodies, gerontechnology, HCI, interactive architecture, tangible interaction

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

INTRODUCTION

Research into technology solutions aimed at easing the difficulties experienced by an ageing population often involves Information and Communication Technologies (ICTs) geared to prevent social isolation or encourage physical activity. However, the two areas are rarely treated as part of the same problem, that is, a sociophysical one.

To date, technology for use by older adults has typically been based on a medical model, for example, home monitoring systems that manage the location and movements of inhabitants, aimed at reducing the risk of injury; telecare devices fall into such a category. Technology is also available to aid with the administration of medication and attempts to fill the gaps that physical and cognitive deterioration leave behind, such as 'smart home technology', which can open doors or adjust lighting [eg. 3, 16]. Another category, 'playful' technology [eg. 7, 21, 22], often utilises Kinect and other gaming systems and may appear to offer an alternative to the medical model but tends to reinforce the notion that all older users are already in need of rehabilitation. However, as can be seen in the initial findings of the scoping study discussed in Robertson et al. [20], older users are a diverse user group, not easily covered by one demographic label. They also, like younger users, utilise mainstream technology—sometimes appropriating it in novel ways and often with little awareness that they are in fact quite 'technology literate'—a reality that is not readily found in government reports on ageing, or gerontechnology studies. There are obvious stereotypes of the 'older user' that are still in effect in popular thinking, but research disciplines like Science and Technology Studies (STS) aim to expand on the solutions-to-problems approach of disciplines like gerontechnology, and add considerations of contexts of use, social norms, traditions [12] and the embodied interactions of actual people.

Since the work of phenomenologists like Heidegger in the 1920s, considering mental life and everyday experiences as fundamentally intertwined is not a novel approach. Such an embodied view acknowledges that thinking about action and performing action is one and the same thing [5, 18, 19] and one in which the built environment also plays a part.

The idea of how humans interact in a physical space, made up of objects and social contexts that influence how they are used and which activities they are used for, is one which researchers like Ullmer & Ishii [23], Hornecker & Buur [9] and Fernaeus, Tholander & Jonsson [6], amongst others, have explored through the development of prototypes. And yet, much of the research into interaction design and Tangible User Interfaces (TUIs) remains focused on one aspect (the physical) isolated from the other (the social).

WELLBEING AND QUALITY OF LIFE

In the literature related to ageing and the implications of what it means to maintain wellbeing, the discussions often revolve around social or physical wellbeing. Blythe, Monk & Doughty [3] and Romero et al. [21] both discuss the declining physical and cognitive abilities of older adults, although the former do so with much sensitivity to the fact that not all older adults should be stigmatised as lacking in either or both of these areas. What such research illuminates is that with increasing age the physical and social activities enjoyed in one's youth become more challenging to maintain, but they do not disappear.

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Romero et al. [21] and Robertson et al. [20] note that while older adults still desire social and physical interaction, part of encouraging technology use is to avoid the creation of entirely new technologies, and therefore, reduce the barriers to their acceptance. Rather, social technology for older users should be built upon existing infrastructure (including non-technical systems) [20], and this, along with the fact that many older adults desire autonomy by way of remaining self-sufficient within the world and their own homes, would suggest that existing infrastructure would be that of the built environment.

DESIGNING TECHNOLOGY FOR OLDER USERS

It is not unusual to find that technologies intended for use by older adults incorporate simplified device interfaces, aimed at easing the load on an assumed reduction in the cognitive, sensory and physical abilities of all older users. In a study by Pedell et al. [16], approximately half of the medical and aged care experts (9 out of 17) interviewed believed that older adults would use technology more when interfaces were easier to use. While there is little evidence to suggest that 'dumbing down' interfaces is an adequate solution, it highlights that another assumption is at work—the assumption that activities always occur in front of a typical Graphical User Interface (GUI)/desktop paradigm, when in fact they need not. Various research from the fields of architecture and environmental psychology [eg. 2, 13, 17] have for the last few decades discussed how the built environment is both shaped by, and shapes, the behaviour of the people within it. That is, activities occur within it and because of it and are always sociophysical in nature.

Tangible Interfaces

While the field of Human Computer Interaction was borne out of interactions humans had with Graphical User Interfaces (GUIs) embedded into the now familiar desktop computer paradigm, it is a well-discussed fact that ubiquitous and embedded technology has taken over [5, 10, 11]. While our interaction with new technology is still often via touchscreens, keyboards, and mice, new modes of interaction that take advantage of the relationships that exist between computers and the physical world in which they, and we, function are being investigated.

Weiser's original vision of ubiquitous computing (1991) imagined a world where we could interact with technology without any need for an interface because the technology would be so embedded into everyday objects, and thus, the fabric of our daily lives, it would essentially 'disappear' from view. Since then, and as a result of Ullmer & Ishii's foundational work (in 1997) into what they called "tangible bits" [10], tangible interaction has become an area of research that investigates the increasingly diverse array of physical forms and modes of interaction [6].

While some models and frameworks have been developed in order to explain tangible interaction and offer guidelines for its design, most notably by Ishii [10] and Hornecker & Buur [9], the original definition of tangible interaction developed by Ullmer & Ishii described how physical objects (but not GUIs or traditional input devices) can represent digital information and how physical actions can be mapped to the actions of computers [6].

More recent research shows that in addition to coupling the physical with the computational aspects of technology, intangible representations of data may enhance feedback by synchronously being presented, for example, via digital projections [10]. Many examples of this type of tangible interface exist, focusing on what Ishii categorises as "Interactive Surfaces" or "Tabletop TUIs" [10], which are used for co-located collaborations. Examples of such Interactive Surfaces include *Wellner's Digital Desk* [5], *Urban Planning Workbench* aka *Urp* (Ishii 2008b), *The Envisionment and Discovery Collaboratory* (EDC) [9], and *MR Tent* [24] amongst others.

Since Ullmer & Ishii's initial data-centric definition, Ishii has revised his earlier work, but in the interim, tangible interaction has evolved to include wider views of what this type of interaction can mean. Hornecker & Buur [9] introduce what they regard as "expressive-movement-centred" and "space-centred" views. While the former exploits how the senses are involved in interaction with objects and how meaning is shared between users, as well as user and object, the latter shares much with fields like interactive architecture and interactive art, and the way in which physical space can be used to display objects, enable social and computer interactions and include intangible representations such as sound or video displays. Hornecker & Buur [9], and subsequently Ishii [10, 11] and Fernaeus, Tholander & Jonsson [6], are of the opinion that tangible interaction encompasses all of the above, and as such, is about much more than using physical objects to display and control digital data.

Unfortunately, despite the evolving models of tangible interaction "[s]o-called tangible interaction, if it happens at all, occurs mostly at the scale of the human hand, seldom at the scale of buildings" [8]. The studies that do investigate full-body interaction with wall or building-sized technologies are mostly relegated to the areas of interactive art, that is, art or museum installations. Examples of these include *Hyposurface* [8] and *Blender* [4]. As such, they are limited in their capacity to direct us as to how to build upon the existing infrastructure of the home.

Interactive Architecture

Interactive architecture has typically related to 'intelligent' buildings and how they respond to specific events. An example could be a building whose sunshades lower in response to sunshine [8]; however, such buildings are typically unable to process context. For example, the sunshades already mentioned may rise when a cloud passes over a sensor while the rest of the building is bathed in sunlight.

This area of architecture uses a variety of terms to define its subject matter, they include: intelligent architecture, responsive architecture, intelligent kinetic systems, smart environments, and even ambient user interfaces [15].

While a deeper investigation into these labels is outside the scope of this paper, the literature suggests that the most important of these relate to "intelligent" and "kinetic".

Pan & Jeng [14] offer an interesting proposal about using smaller kinetic robots to form larger kinetic buildings, envisioning a world that doesn't seem possible with today's level of technology and materials, but may one day see Ivan Sutherland's 1965 vision of a world where buildings and homes are made up of "Ultimate Displays", that is, rooms "within which the computer can control the existence of matter [… and a] chair displayed in such room would be good enough to sit in" [15, p. 62].

One of the challenges of interactive architecture lies in making buildings contextually aware, but interestingly, this challenge is not unique to architecture. Tangible technology is also challenged by the fact that users often do not behave according to a pre-defined sequence of steps. Regardless of the type of technology being discussed the needs of older users are not equal, therefore designing for a population that is ageing (but not yet elderly) poses design challenges that are worthy of further investigation.

HOME IS WHERE THE HEART(H) IS

The research of Robertson et al. [20] and Blythe, Monk & Doughty [3] supports that older adults want to keep their autonomy and independence within their own homes for as long as possible. Certainly, reduced mobility and cognitive function may make leaving the home more difficult and lead to social isolation, but research into playful persuasive technologies that are added to existing systems [21], and simple telecommunications technologies used in novel ways, such as Net Neighbours [3], demonstrate that remaining physical and social—as well as being motivated to be so—is entirely possible within the walls of one's home.

Research into how these innovations can be brought into the field of interactive architecture is limited, although the work by Adi & Roberts [1] comes close. They created two buildings within the virtual world of Second Life; one was static and the other reacted to user movement by lighting up floor panels and moving walls based on users' proximity to them. Their findings showed that the building with interactive elements was more engaging and encouraged people to visit, spend more time in, and socialise there. For the purposes of this paper, there are obvious concerns about drawing any immediate conclusions from Adi & Roberts' study. Issues with doing so include that (a) it was not focused on older adults, (b) it dealt with a very specific user population (that is, Second Life users) and thus could not be said to be based on a socially dependable design and (c) the interactive building was only a simulation which may not translate exactly into the built environment.

CHALLENGES

There are several challenges that arise from the various areas of research discussed in this paper. While some have to do with assumptions around ageing, others have to do with the practical reality that technology and the sophistication of materials has a long way to go before it can truly adapt to the unique needs of older users while remaining contextually and bodily-relevant and usable.

Other issues include:

• User privacy—how the collection and use of information, by a system that tracks a user's behaviour within their home, might be explained to a user in order to receive their consent for its installation.

• Cost—smart homes and similar forms of technology integrated into kinetic buildings are typically expensive. While Pan & Jeng [14] look into the use of lower cost and easier to install and maintain architectural robots, it is likely that they will still be out of reach for those living in poorer areas [3].

• Culturally-specific and ethical issues—the desire for ageing populations to maintain their independence is mostly a Western phenomenon. Other cultures may view the desire for technology to enable this way of life as unethical [3].

• Designing for the 'ageing' not the 'elderly'—the extant literature in this area focuses on solutions for those already considered as physically and/or cognitively impaired. However, the same literature highlights that technology designed in such a way carries a stigma that acts as a barrier to its adoption. Perhaps focusing on the development of technology that maintains wellbeing in younger (older) users and encourages earlier adoption could overcome such barriers. Similarly, designing for 'ageing' may benefit from a paradigm shift, that is, from designing for today's users to designing for a decades-long process. Doing so may address needs that are not yet apparent to users, so that when they become so, the technology solutions are already in place.

• Incremental design—in addition to the barrier to technology adoption generated by stigma, entirely new technology is not used because it is either too difficult to learn or not part of the existing daily routines and lifestyle structures of its users, thus increasing the reluctance to use them [21]. A deeper understanding of what leads to the appropriation of technologies like Facebook, email, and certain mobile devices, would be worthwhile but has been outside the scope of this paper.

• Sociophysical interactions—future research needs to investigate *both* the social and physical aspects of interactions and technology use, as both are tightly integrated and have consequences for maintaining wellbeing.

CONCLUSIONS

This paper attempts to introduce and navigate the extant work of designing technology for older users and considers the potential for interactive architecture to provide support for ageing users well into their later years. It also highlights that assumptions about the cognitive and physical capabilities of older adults should be avoided and that the context-specific needs of this

diverse group should be addressed if remaining barriers to technology adoption are to be overcome.

While feasibility issues related to user privacy and cost—in addition to the current limitations of material and computational technology—make wholly intelligent buildings presently out of reach, the work of Adi & Roberts [1] supports a vision of a world where the built environment might provide for the sociophysical needs of ageing users. Similarly, investigations into newer Tangible User Interfaces and their integration into larger systems (such as domestic buildings) suggest that they too may one day be flexible enough to handle the evolving embodied interactions of ageing bodies.

ACKNOWLEDGMENTS

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OZCHI 2012 - Integration, Interaction, Innovation, Immersion, Inclusion

The Australasian Computer Human Interaction Conference

Proceedings of the 2nd International Workshop: The Body In Design

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The 2nd International Body in Design Workshop

OZCHI 2012 Integration, Interaction, Innovation, Immersion, Inclusion. The Australasian Computer Human Interaction Conference, November 26th, Melbourne, Australia

Lian Loke and Toni Robertson (eds)

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Faculty of Engineering and Information Technology

University of Technology, Sydney

http://research.it.uts.edu.au/idhup/

The Workshop Call for Participation

With the emergence of mobile, tangible, ubiquitous and wearable computing, the body is brought to the fore as the essential and defining site of interaction and experience. This renewed attention to the body brings with it new challenges for design, moving beyond ergonomics and the communicative roles of the body to deeper considerations of the social and ethical issues that come with opportunities provided by emerging digital technologies. It also throws into debate how we go about designing for the active and engaged body in technology-mediated situations. Our interest in this workshop is to stimulate debate and critical thinking on the current rise in interest in designing for bodies and embodied interaction.

It is the second international "Body in Design Workshop" and builds on the first workshop held at OZCHI 2011 in Canberra. It continues the focus of the first workshop on the body itself and the role of embodiment in lived experience, with a view to informing design research and practice. This one-day workshop aims to bring together a diverse community of researchers and practitioners working on human-centred approaches to understanding the body in the design of interactive technologies. A number of central themes were identified during a collaborative contextual mapping/card-sorting activity run as part of the previous workshop. These themes are listed below and will form a starting point for our discussion:

- Designing for bodily experience
- Bodies with histories
- Socio-physical, aesthetic, expressive and playful interactions
- Bodily engagement in the design process
- Evaluation methods and frameworks

Contents

Introduction

Welcome to the 2nd international workshop "The Body in Design" being held as part of OZCHI 2012 - Integration, Interaction, Innovation, Immersion, Inclusion, in Melbourne, Australia on November 26th, 2012.

Contributors come from Australia, Denmark, and the Netherlands. The papers focus on a number of different areas within the workshop theme. And reflect the broad multi and interdisciplinary backgrounds and commitments of the participants.

All papers were subjected to at least double refereeing by a panel of researchers in this and related fields. A list of reviewers is included in these workshop proceedings.

The ISBN for the proceedings is 978-0-9757948-6-9.

This workshop is the culmination of the hard work of a number of individuals - the conference committee whom we thank for choosing our workshop, the workshop committee, the referees and all the authors and delegates. We would like to thank them all for their invaluable contribution. Our special thanks go to the sponsors and supporting organizations as well as our student volunteers for their generous support.

Supporting organisations and Sponsors

The Australasian Computer Human Interaction Conference, OZCHI 2012, Melbourne.

Interaction Design and Human Practice Laboratory (IDHuP), University of Technology, Sydney (UTS)

Centre for Human Centred Technology Design Research (HCTD), UTS

Workshop organisers

Lian Loke, Design Lab, University of Sydney

Toni Robertson, Faculty of Engineering and Information Technology, University of Technology, Sydney

Webpage

For more details, visit our workshop web site:

http://research.it.uts.edu.au/idhup/workshops/2nd-body-in-design-workshop-2012/

or the conference website:

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Patrick Burns, University of Tasmania

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OZCHI 2012 The Body In Design Workshop
Reviewing Guidelines

Please provide ratings for each criterion, along with written constructive feedback to enable the author(s) to improve their work.

Paper title: Ageing bodies and the space they call home

Paper file index: P7

Overall acceptance score (bold your selection):

4	3	2	**1**
Strong reject	Weak reject	Weak accept	**Strong accept**

Review Criteria (bold your selection):

1. Originality, interest (Does the paper present original and interesting work?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

2. Relevance to topic (Does the topic of the paper fit into the scope of the workshop call?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

3. Significance (Do you expect this work to have significant impact?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

4. Quality of writing and scholarship (Does the paper position the research to related literature?)

0	1	2	3	**4**	5
Missing	Weak	Borderline	Fair	**Good**	Excellent

5. Readability and organisation (Is this paper well written?)

0	1	2	3	**4**	5
Missing	Weak	Borderline	Fair	**Good**	Excellent

Summary of contributions (tick relevant categories):

- ☑ theory
- ☐ methods
- ☐ tools
- ☐ analytic
- ☐ case study
- ☐ study of practice
- ☐ other: (specify)

Suggestions for improvement: (provide informative and constructive feedback to enable author to improve paper)

An interesting and relevant piece of theoretical work on designing technology for ageing bodies. It deconstructs assumptions around ageing bodies and the elderly, and proposes a consideration of solutions that treat the social and the physical as a unity that is shaped and supported by the built environment, as well as the technologies embedded in it. The reading list is a useful resource.

Reviewer's degree of knowledge/expertise (tick relevant category):

- ☐ Expert
- ☐ Familiar with subject matter
- ☑ Passing knowledge
- ☐ No knowledge

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0	1	2	3	**4**	**5**
Missing	Weak	Borderline	Fair	**Good**	**Excellent**

2. Relevance to topic (Does the topic of the paper fit into the scope of the workshop call?)

0	1	2	3	**4**	**5**
Missing	Weak	Borderline	Fair	**Good**	**Excellent**

3. Significance (Do you expect this work to have significant impact?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

4. Quality of writing and scholarship (Does the paper position the research to related literature?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

5. Readability and organisation (Is this paper well written?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

Summary of contributions (tick relevant categories):

- ☒ theory
- ☐ methods
- ☐ tools
- ☐ analytic
- ☐ case study
- ☐ study of practice
- ☐ other: (specify)

Suggestions for improvement: (provide informative and constructive feedback to enable author to improve paper)

Having had some insights into aged care I totally agree with the author that too often, physical activity and social isolation are treated as if they are distinct challenges, at least by those technology designers that aren't actually familiar with the situation. The paper is well written and very relevant to the workshop, and will certainly open up exciting discussions.

Reviewer's degree of knowledge/expertise (tick relevant category):

- ☒ Expert
- ☐ Familiar with subject matter
- ☐ Passing knowledge
- ☐ No knowledge

OZCHI 2012 The Body In Design Workshop
Reviewing Guidelines

Please provide ratings for each criterion, along with written constructive feedback to enable the author(s) to improve their work.

Paper title: Ageing bodies and the space they call home
Paper file index: P7

Overall acceptance score (bold your selection):

4	3	2	**1**
Strong reject	Weak reject	Weak accept	**Strong accept**

Review Criteria (bold your selection):

1. Originality, interest (Does the paper present original and interesting work?)

0	1	2	3	**4**	5
Missing	Weak	Borderline	Fair	**Good**	Excellent

2. Relevance to topic (Does the topic of the paper fit into the scope of the workshop call?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

3. Significance (Do you expect this work to have significant impact?)

0	1	2	3	4	**5**
Missing	Weak	Borderline	Fair	Good	**Excellent**

4. Quality of writing and scholarship (Does the paper position the research to related literature?)

0	1	2	3	**4**	5
Missing	Weak	Borderline	Fair	**Good**	Excellent

5. Readability and organisation (Is this paper well written?)

0	1	2	3	**4**	5
Missing	Weak	Borderline	Fair	**Good**	Excellent

Summary of contributions (tick relevant categories):

- ☐ theory
- ✶ methods
- ☐ tools
- ☐ analytic
- ☐ case study
- ☐ study of practice
- ☝ other: (specify) This paper sets out a framework within which the issue of using ICT to help older people remain in their own homes can be discussed.

Suggestions for improvement: (provide informative and constructive feedback to enable author to improve paper)

I think that this paper represents an important approach to the broad topic of using ICT to help people remain in their own homes as they age. In contrast to special interest approaches, such as intelligent/telehealth medication management or physical modification of the home with ramps, wide doors and hand rails, this paper suggests a broader range of approaches with a focus on the actual needs of the users.

Points that I particularly like:

- The idea of adapting mainstream technologies for this purpose (in contrast to developing special-purpose technologies for the aged).
- The idea of focusing on both the social and physical aspects of living as an older person
- The idea of building on existing infrastructure (meaning the existing built environment) and by implication building on the things with which the target older people are already familiar.
- A dot point in the Challenges section which could perhaps be made stronger. "Designing for the "ageing" …" could (and maybe should) be seen as designing for the decades-long

process of ageing so as to anticipate and head off problems by having working solutions already in place. This would be consistent with the Ullmer and Ishii concept that the <technology> would essentially disappear from view.

What I would like to see (possibly in a subsequent paper) are:

- A field-work plan to gather data about the target audience(s) for this work. There may be several such audiences – aged-care communities, suburbs with an older demographic, extended families are three that jump to mind. Maybe this research could move into an Action Research mode with a small number of longitudinal case studies.
- Some focus on the "social". Maybe this will draw more heavily on the "Communications" part of ICT or maybe it relates to portability and compactness of support technology so that older people can create pleasant living spaces within their homes to entertain their friends and acquaintances.
- I think that the "incremental design" dot point is actually very relevant. Older people often live in a multi-generational environment so the migration of Facebook, email and smart phones from their younger friends and relations into their own lives is already happening and should be in scope for the workshop discussion to come from this paper.

Reviewer's degree of knowledge/expertise (tick relevant category):

☐ Expert
☐ Familiar with subject matter
✶ Passing knowledge
☐ No knowledge