Tangibles for Health Workshop

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Abstract
eHealth research employing technology and HCI to support wellbeing, recovery and maintenance of conditions, has seen significant progress in recent years. However, such research has primarily focused on mobile "apps" running on commercial smartphones. We believe that Tangible User Interfaces (TUIs) offer many physical and interaction qualities that would benefit the eHealth community. Yet, there is little research that combines the two. Tangibles for Health will bring together leading researchers in tangible user interaction and health to explore the potential of tangibles as applied to healthcare and wellbeing.

Author Keywords
Tangible User Interfaces; Healthcare; e-Health; Wellbeing; Accessibility; HCI

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

Background
Recently health and wellbeing research has largely focused on the role of mobile smartphones and wearable sensors. Both academic and commercial work has investigated the role of "apps" running on touchscreen mobile devices, and simple wearable devices [4] (such as fitness trackers). These can be used to monitor health

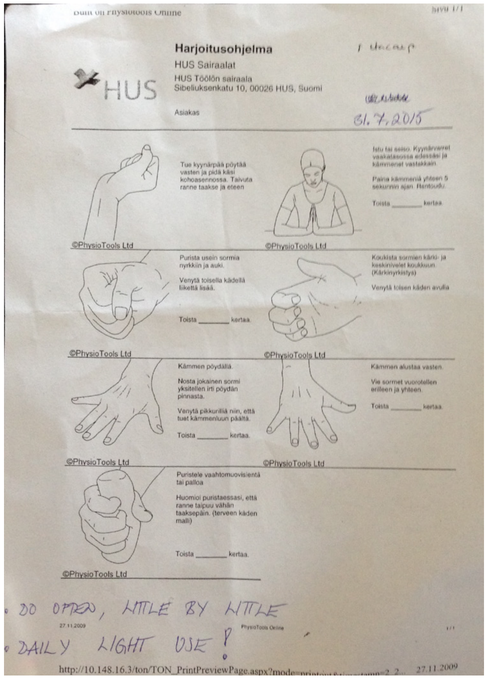

Figure 1: Example sheet of rehabilitation exercises to be completed after a physical injury.

levels, and support the management of long-term physical and mental conditions.

However, whilst mobile devices and trackers have been extensively studied, there has been less focus on other human-computer interaction (HCI) paradigms that could be employed to better support health and wellbeing, and on the benefits that they might bring over existing mobile approaches. In particular, the use of Tangible User Interfaces (TUIs), where physical objects are not only used to represent digital information - giving the virtual data graspable embodied form, but also as a method of control - allowing the data to be simply picked up and manipulated. Tangible User Interfaces (TUIs) encourage the adoption of certain modes of interaction that may benefit healthcare applications. TUIs also use a wide variety of form factors and materials with physical properties beneficial for different settings and users. For example, TUIs that use soft fabrics and materials with different textures can be used for cognitive assistance and therapy. Peripheral interaction, where a tangible interface can slip in and out of a user’s awareness, and slow technology where a tangible has been designed to encourage slow, playful and contemplative reflection are already demonstrable in TUIs. More generally, TUIs are considered easier to use and learn as they draw upon physical affordances and constraints, and support cognition through physical representations, use of epistemic actions, and spatial manipulation [13].

It is clear there is a significant advantage for both the tangible and eHealth communities to work together to deliver breakthroughs in physical and mental health, disability and wellbeing, and provide a roadmap for future discovery. CHI provides the best opportunity to bring together these two communities as the best researchers in each already attend the conference, and both areas are established in the CHI community. To highlight the potential impact of applying tangible interaction to healthcare, we outline four areas: rehabilitation, accessibility, age interaction, and awareness and monitoring. These are not exhaustive, and there are many more areas of health where tangibles could be applied. We will work hard to bring a wide range of both health and TUI researchers together to the breadth of tangibles for health.

Rehabilitation

With many physical injuries, from broken bones to stroke, it is necessary for patients to carry out rehabilitation to regain effective use of their limbs. Although a physiotherapist will meet with the patient to decide on the best set of exercises, the majority of the exercises are done at home, often with only a simple paper representation as a guide (see Figure 1). Even with physical props (e.g., a squeeze ball), the repetitive nature of the exercises means patients often discontinue use, leading to poorer rehabilitation outcomes [6]. Researchers have considered exergames to increase participation rates, and with success [15]. However, there are issues in how exercises can be made to "fit in" from both a physical and social perspective [1]. The areas in the home most suitable for rehabilitation are often kept for relaxation (e.g. areas with comfortable chairs, or with the Television - often assumed to be available by exergaming approaches for the display of interactive visualizations [10,15]). This is partially due to the "clinical" nature of rehabilitation equipment and, in some cases, the need for it to be left setup. Tangible solutions have the potential to overcome many of these problems. Tangible objects could be designed to be smaller and more compact, with their physical design affording the interaction necessary to complete an exercise [5]. With varying materials and dynamic interactions, such devices could better fit both practically and aesthetically into the home, and provide interactive engagement to encourage users to continue rehabilitation.

Accessibility

A key area where TUI research can have significant impact is in making technologies more accessible to those with physical disability or impairment. For those without sight, tangible interaction is a primary interaction technique. Children in school already access tangible representations of data visualizations as a way of supporting understanding [2], similarly sculpture and other physical art forms are the norm. However, until recently, accessing digital data eschewed such physical interaction. Recent work has begun to apply basic Tabletop TUI research to accessibility, finding it can combine the benefits of existing tangible interaction, but support effective interaction and manipulation of digital data [11]. Kane and Bigham have begun to consider how 3D printing can be used to help blind children learn programming [8]. Using 3D printed models as the output of a computer program to help blind children understand its execution. Such work highlights the benefits of accessible TUI research, and how it might help inform cutting edge developments in tangible interaction, such as recent work by considering the potential benefits of tangible representation of data for all users [7] However, such work is still at a very early stage.

Aged Interaction

The world population is ageing. In the UK, by 2050, over 39% of adults will be aged over 64 (compared to 24.4% in 2000). This will lead to both an increase in the number of technologically literate older users, and an increased reliance on interactive technologies to provide and support many health and social care services. These will promote and support healthier living, and diagnose and support self-management of long-term conditions. Yet whilst such adults will be computer literate, the physical and mental effects of ageing will be more present, and it is vital that the technologies they will need to interact with are digitally accessible. Interaction with conventional mobile and other computing devices is particularly challenging for Older Adults. The small buttons, lack of physical stability (e.g. when holding a smartphone) and lack of tactile feedback make targeting difficult for all users. This is exacerbated for many older adults due to deteriorating vision and the age-dependent increase in involuntary muscle tremor [9]. Older adults often experience motor and vision impairments that can affect their ability to use touchscreen keyboards for example [3]. Unexpected touchscreen responses (either unregistered or unintentional touches) are a major cause of frustration for older users [14]. In addition, older users often have multiple conditions, making it difficult to design a "one size fits all" UI. The wide variety of materials and form factors that TUIs support for interaction can allow interfaces that can 'work around' these conditions, tailoring the materials of the interaction and its physical properties to fit with the conditions of an individual user.

Motivation, Awareness and Monitoring

A final area of application is in encouraging and supporting fitness activity. Wearable devices that record performance data are common. Curmi et al. [4] developed HeartLink, a tool that shared triathlete and runner biometric data in real-time on a website that created a sense of togetherness among viewers. Viewers felt more connected with runners when they could see their heart rates. Athletes, who knew their data was being shared online, felt like people were around them and cheering when they were alone. Such approaches, however, only provide access via a website or visual display. This provides limited interaction whilst actively undertaking an activity.

TUIs have supported improved awareness through ambient data displays to motivate triathlon athletes [4], cyclists [16], and high intensity exercise communities, supporting improvement in performance. Walmink et al. [16] developed a display for bicycle helmets that displayed their current heart-rate. The visual heart rate data created a shared experience because cyclists relied on their partner to relay the information. Paired cyclists experienced similar levels of exertion and created a sense of social support and team building. Oakes et al. [12] developed MuscleMemory to promote camaraderie and increased communication between high intensity exercise participants through wearable visualizations on an athlete's knee. Such examples go far beyond what is possible with conventional visual displays, with TUIs provoking the ability of social interaction between participants to promote community in individualized exercises. As such these have the potential to provide peer support in exercise which can improve participation.

Workshop Goals and Objectives

The primary goal of this workshop is to bring together leading researchers in Tangible User Interaction and health to explore the potential of tangibles as applied to healthcare and wellbeing. Although there is strong potential (as previously outlined) of cross-pollination of ideas between these two fields, there is currently little work in establishing a research community between them. A workshop at CHI is the ideal and best venue to do so, with a strong contingent of both tangible researchers and eHealth researchers as participants. While there may be more tangible researchers at a conference such as the ACM TEI Tangible Embedded and Embodied Interactions, we would not find a large enough proportion of health researchers, which is critical to balance our workshop. The Workshop on Interactive Systems in Healthcare (WISH) will also be held in San Jose during CHI 2016, and provides additional opportunities for successful and fruitful collaboration. We will aim to attract WISH attendees to our workshop, and to CHI in general.

The main outcome of the workshop is a research agenda to study and understand the role TUIs can play in future health interaction. We want to understand how existing tangible research could apply to current challenges in health and wellbeing research. This workshop will allow us to do this, and identify how those challenges can drive tangible research. These outcomes will be published both on our website, a poster at the conference and as an Interactions Article to support community building.

Organizers

The organizers represent a rich mix of leading researchers in tangible interaction, health and exploring the interaction between them.

Audrey Girouard is an assistant professor in the School of Information Technology at Carleton University. Specializing in next generation interactions, her research focuses on deformable user interactions using flexible displays and bend gesture inputs. She is currently exploring the deformation of displays and objects for hand dexterity rehabilitation and for physically impaired populations.

David McGookin is an assistant professor in Computer Science at Aalto University. His research focuses on multimodal and multisensory interaction for computer interfaces, particularly with regards to location-based interaction and interfaces for physical impairments. He currently leads work on the Nordforsk ActivABLES project developing tangible solutions to better support Stroke rehabilitation.

Katie Siek is an associate professor in Informatics at Indiana University Bloomington. Her primary research interests are in human computer interaction, health informatics, and ubiquitous computing. Related to the workshop, Katie's lab has designed and developed wearable technologies that assist with knee rehabilitation, personal feedback for squats, and empowering children to build their own health sensing technologies.

Orit Shaer is an associate professor of Computer Science and Media Arts and Sciences at Wellesley College. Her research focuses on the application of tangible and embodied interaction to scientific discovery, collaborative learning, and health informatics. She is a primary investigator on a 3-years NSF funded project, which explores the role of HCI in personal genomics. Related to this workshop Orit's lab has developed novel interactive visualizations for personal genetics and experimented with tabletop interface for allergen detection, as well as wearables for wellbeing.

Marilyn Lennon is a senior lecturer in Human computer Interaction. She currently holds a Chancellor's Fellowship position in Technologies for Health and Wellness in the School of Computer and Information Science at the University of Strathclyde. She has held several grants investigating novel multimodal technologies for health and wellbeing, capturing complex requirements for the design of smart homes and personalisable reminder systems for older adults. She is currently lead research scientist on the £37M Innovate UK funded dallas programme evaluating the benefits and impact of digital health technologies at scale in the UK.

Peter Bennett is a Research Assistant in Computer Science at the University of Bristol whose research focuses on the design of new Tangible User Interfaces. Peter has recently worked on the Tangible Memories project, designing novel storytelling and reminiscence systems for encouraging social interaction in care homes for the elderly.

Website

We will use a wordpress.org site as the conference website. This provides a flexible platform to both communicate and share with participants. We have registered the address tangibles4health.com that will point to this site. Please note the site is not yet live.

Pre-Workshop Plans

All organisers have a strong research presence in either Tangible User Interaction or Health, or work at the intersection of both. Therefore we have good links in both communities. We will distribute the CFP through leading HCI and healthcare mailing lists (e.g. SIGCHI Announcements, DHI – digital Health Institute (Scotland), SCTT – Scottish Centre for Telehealth and Telecare, British Computer Society – Human Computer Interaction Branch, Caring Tech (assisted living researchers network), JISCM@ail, American Medical Informatics Association and the Workshop on Interactive Systems in Healthcare (WISH)), and existing tangible and health community Facebook and other social media pages (e.g. the TEI Facebook group).

In advance of the workshop, we will distribute the accepted papers to all participants. We will also setup a Facebook group that will act as a forum for all participants to meet and start discussions before the workshop. We will employ the "provocation" approach (see workshop structure) to foster discussions and build a community on the Facebook page. Participants will submit their provocation point on Facebook, and we will collate the points in one document, and encourage everyone to read it prior to the workshop.

Workshop Structure

The workshop will run over 1 day. The workshop will work best if participants can group around tables (for physical brainstorming activities). Additional tables and power sockets may be needed to support demos. A standard projector is needed for the presentations.

We will thematically group short presentations (3 slides, maximum 3 minutes) by workshop participants. We will implement a Pecha Kucha style presentation with slides automatically advancing to stay on time. These talks will be grouped in complementary themes and a discussion will follow each group. To aid that discussion, each participant will be asked to devote their last slide to a "provocation" - e.g. a consideration of where the research area will be in 5-10 years - and will be asked to bring a physical artifact that relates to their provocation. As tangible research often works best in a demo form, participants will have the option of bringing a demo instead, and these will be grouped together in a session.

After initial presentations, we will mix participants in groups with different expertise and carry out low-fi physical prototyping and body storming techniques. The workshop organizers will supply a range of physical materials suitable for this. Each team will be asked to develop a concept prototype, inspired by the provocations and physical artifacts, of a tangible system to support some aspect of healthcare. These new concepts on how tangibles and healthcare research might be better integrated will provide examples of potential future directions, and allow us to identify common themes and issues that relate to the concepts.

Based on the physical prototyping, we will identify potential opportunities where both tangible research might be applied to healthcare, as well as how healthcare can drive new research in tangible interaction. The remainder of the workshop will be spent in focused group discussions to discuss these opportunities. Participants will be split into groups, with each asked to discuss one of the identified themes from the physical prototyping, and derive a set of research questions needed to develop each theme.

We wrap up with a group discussion on next steps in developing health related tangible user interaction. We will also discuss the possibility of future workshops with participants, as well as their ideal locations. Although outwit the formal workshop program, we will organize a dinner with willing participants that evening to continue our discussions on the future tangible role of healthcare. We will inform participants of the workshop dinner at least a week prior to the workshop to avoid losing participants to indecision or prior plans.

Workshop Schedule

9.00-9.10	Welcome and Introductions
9.10 - 9.55	Thematic Group A Talks (approx. 7 x 3mins) + Discussion
9.55-10.30	Thematic Group B Demos (into coffee break)
10.30-11.00	Coffee break
11.00-11.45	Thematic Group C Talks (approx. 7 x 3mins) + Discussion
12.00-13.30	Lunch

13.30-14.00 Physical Prototyping + BodyStorming Introduction and Group Forming
14.00-15.00 BodyStorming Activity
15.00-15.30 Coffee Break
15.30-15.50 Discussion on BodyStorming Activity
15.50-16.30 Discussion Groups on Research Qs and Issues
16.30-17.00 Report Back from Discussion Groups
17.00-17.15 Conclusions + Wrap-Up
20.00 (approx.) Workshop Dinner

Post-Workshop Plans

Post-workshop our goal is to create clear, tangible and long-lasting outcomes. We will create a poster to be displayed at the conference to capture our initial outcomes. We will then co-author an interaction article both outlining the workshop, its findings and proposing a new research agenda based on its results. This will act as a starting point to support the effective collaboration between the health and tangible research communities. We hope this will lead to further workshops and dialogues between these communities.

Call for Papers

Health research is a rapidly growing field. While many technologies may be suitable for e-health, we notice that many researchers currently focus on mobile technologies. We believe that Tangible User Interfaces offer many physical qualities that could suit the health application domain. Yet, there is little research that combines the two. This workshop will bring together leading researchers in tangible user interaction and health to explore the potential of tangibles as applied to healthcare and wellbeing. The workshop will be curated, with the organizers selecting participants based on relevance to the workshop themes[1], and to include a good balance of different backgrounds.

Authors should submit either, a 4-5 page position paper, or a 2-4 page demo description and video, both in the CHI EA format. Authors submitting a demo are expected to bring that demo to the workshop. Videos should be uploaded to a video sharing site, with a link included in the paper. Note that demos do not need to be specifically focused on health, but the demo description should make clear how they might be applied. Both position papers and demo descriptions should include at least a 1 paragraph provocation: A speculative viewpoint on how the combination of healthcare and tangible interaction can evolve and where you see it in 10-15 years.

Submissions should be emailed in pdf format to submissions@tangibles4health.com. At least one author of each paper must register to attend both the workshop and at least one day of the main conference.

Early Submission Deadline: 17 December 2015
Early Acceptance Notification Date: 21 December 2015 (see https://chi2016.acm.org/wp/workshops/)

Based on the papers accepted in the early acceptance round we will have a further final deadline submission:

Final Deadline: 12 January 2016
Final Notification Date: 15 January 2016

Final submissions: 12 February 2016

[1] A full list of topics will be included in the final CFP. We had to omit it due to space constraints.

More details are available the workshop website: tangibles4health.com

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