Addressing the Challenges of Situationally-Induced Impairments and Disabilities in Mobile Interaction

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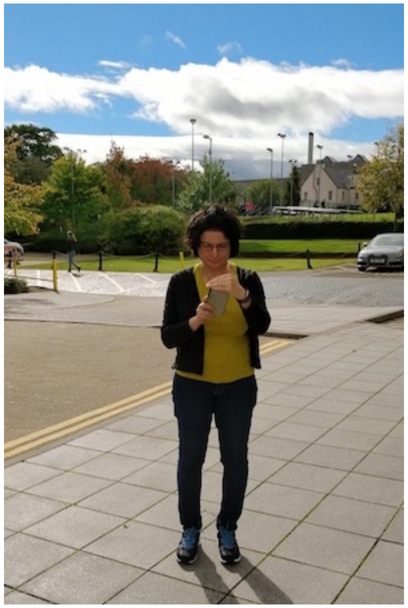

Figure 1: A person trying to use their smartphone while under bright sunlight.

Figure 2: A person completing smartphone tasks in a cold chamber.

ABSTRACT

Situationally-induced impairments and disabilities (SIIDs) make it difficult for users of interactive computing systems to perform tasks due to context (e.g., listening to a phone call when in a noisy crowd) rather than a result of a congenital or acquired impairment (e.g., hearing damage). SIIDs are a great concern when considering the ubiquitousness of technology in a wide range of contexts. Considering our daily reliance on technology, and mobile technology in particular, it is increasingly important that we fully understand and model how SIIDs occur. Similarly, we must identify appropriate methods for sensing and adapting technology to reduce the effects of SIIDs. In this workshop, we will bring together researchers working on understanding, sensing, modelling, and adapting technologies to ameliorate the effects of SIIDs. This workshop will provide a venue to identify existing research gaps, new directions for future research, and opportunities for future collaboration.

CCS CONCEPTS

• **Human-centered computing** → *Ubiquitous and mobile computing*;

KEYWORDS

Situational impairments; SIID; Accessible computing; mobile devices; wearables; IoT.

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BACKGROUND

Situationally-induced impairments and disabilities (SIIDs) are experienced by people when they find it challenging to complete tasks due to the particular context that they are in (e.g., Figures 1–4). In addition to environmental factors [15], we must consider a wider context [24, 25].

Mobile devices (e.g., smartphones, tablets) have arguably become vital pieces of technology that allow users to work in a diverse number of contexts (indoor and outdoor environments, while travelling, etc.), yet we need to consider how to design to reduce mobile device situational impairments [31]. Moreover, the importance of addressing SIIDs further increases when we consider wearable devices (e.g., smartwatches, fitness trackers, smartglasses) because these technologies are also susceptible to interaction challenges due to changing contexts. More research is required to fully understand and address SIIDs when using mobile devices [19]. Research on SIIDs falls within four main components: Understanding, Sensing, Modelling, and Adapting, which we describe next.

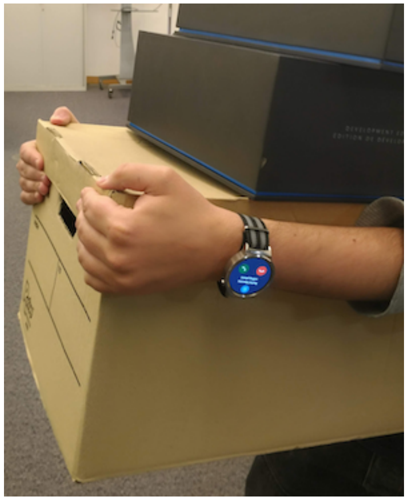

Figure 3: A person carrying boxes when their smartwatch rings.

Figure 4: A person browsing the Internet in the dark.

Understanding

To successfully address SIIDs, it is critical that we understand what effect *context* has on use. Within HCI, context is not defined by a single attribute, but rather context is derived from the combination of a user, an application, and a location [2]. Research looking to understand the effect of SIIDs on interaction must therefore consider multiple factors to identify how to approach reducing SIIDs.

Studies have investigated the challenges that walking impose on mobile interaction [14], how cold environments affect common smartphone tasks [7, 18], what factors are involved when experiencing SIIDs during visual tasks with mobile devices [27], and how encumbrance can decrease target acquisition time [16]. Moreover, ambient noise has been shown to adversely affect mobile interaction [20]. In particular, music decreased target access time and accuracy, while urban noise and speech decreased typing speed [20]. Further work is needed to address severe SIIDs [22].

SIIDs are an accessibility challenge and so studies have investigated understanding how people with visual and motor impairments use mobile devices when outside of their homes [9], what input errors and challenges are similar between people using small devices and people with a motor impairment using a desktop [34] and people with low vision [33], while tools designed to support speechreading [8] could address situational hearing loss. Because of the relationship between conventional accessible computing research and research into SIIDs, Wobbrock argues that understanding SIIDs would also increase our understanding of needs for improved accessibility and adaptive user interfaces [31].

Sensing

Previous work has argued that detecting SIIDs is a fundamental step towards the successful adaptation of mobile interfaces [19]. Furthermore, understanding the abilities of people who are in constrained environments is integral for the ability-based design approach (i.e., consideration of what users can do rather than what they cannot do, forcing systems to adapt to users rather than the other way around) [32]. Solutions should ideally leverage the built-in sensors of mobile devices to avoid burdening the users with additional instrumentation [21]. For example, mobile device ambient light sensors adjust screen brightness for comfortable viewing. However, users find the ambient light sensor can be slow to adjust or choose an unsatisfactory level of brightness, resulting in the feature often being disabled [27]. Sarsenbayeva et al. [21] suggest using smartphone's battery temperature to detect ambient temperature drop. Similarly, Goel et al. [5] utilised a smartphone's accelerometer sensor to detect walking and adapt the keyboard to reduce errors and increase typing speed.

The automatic detection of SIIDs during mobile interaction opens the way to relevant interface adaptations; thus, allowing interactions with mobile devices to be more appropriate to the user's context, but first the data must be modelled in some way.

Modelling

Modelling either the user or the environment can provide us with great insights into SIIDs. Prior work has shown success in modelling the colour perception of people with and without impaired colour vision [4], as well as using situation-specific models of colour differentiation to improve recolouring tools [3]. An online study modelled ~30k web participants' ability to differentiate screen colours, and then using the data, a design tool was created to show designers problematic colours for various percentages of the population [17]. Additionally, there is ContextType, which modelled whether the user was holding the device in one or two hands, and which hand it was, and then adjusted the underlying touch screen keyboard model to accommodate the grip posture [6].

Considering the range of SIIDs that a user might experience, it is imperative that more research is dedicated to building models, as this will allow for the development of robust SIID solutions. Currently there is a gap in innovative simulations of environments for designers to understand how users interact within constrained environments. Simulations of impairments are important and a necessary feature for accessibility-focused design tools (e.g., to support designing for impaired colour vision [26]). Research has found early-career designers typically do not address SIIDs for visual tasks and they have requested better support (e.g., new guidelines) than what is currently available [28]. Some initial work has explored the possibility of modelling SIIDs by requesting people play a mobile game that collects data to be used to inform new design guidelines [11]. Our workshop will provide a venue to further explore ways to model users and the environment to inform better solutions for SIIDs.

Adapting

Adaption has been used to improve interaction according to context. Studies have investigated improving interaction and typing accuracy while walking [5, 10], assisting users in task resumption after interruption or distraction [12], and improving interaction with touch screens in the rain [29]. In terms of design solutions, researchers have shown that increasing target size [23], providing audio guidance [30] and adaptive text entry [5] can compensate for the negative effect of SIIDs.

There are a great number of currently-available techniques that can be leveraged to improve the interaction with mobile devices, once the SIID has been detected. For instance, the Fat Thumb technique can be used to improve mobile interaction [1] when the user is situationally-impaired due to encumbrance – a smaller contact size for panning and a larger contact size for zooming. Another example is the GraspZoom [13] input model that uses pressure sensing to define different gestures with the help of a Force Sensitive Resistor, used to determine the strength of the pressure.

Goals of the Workshop

The constant evolution of technology means that our understanding of SIIDs will need to evolve accordingly, particularly when dealing with new types of interactions. Our understanding of mobile devices is changing as development of wearable devices and IoT (Internet of Things) continues, and, as a result, SIIDs will become even more critical in the future. We need to consider the new ways in which we interact with devices (e.g., voice controlled AI assistants, squeezable hardware such as the "active edge" feature of the Google Pixel 2 smartphone) and also other technologies that are becoming a standard feature in our devices (e.g., VR and AR). We not only need to continue developing our understanding of new SIIDs, but we must also identify intelligent methods to enable technology to adapt to unforeseen situations.

We have four main goals for this workshop:

- Allow organisers and participants to share their expertise and insights on SIIDs.
- Identify gaps in the research.
- To ideate solutions that mitigate the effects of SIIDs when using interactive technology.
- Create and strengthen a collaborative network that will span several continents.

WORKSHOP ORGANISERS

The workshop organisers are all experts in SIIDs and interaction with mobile devices, and frequent publishers of papers in top venues on this research topic. Most have also successfully organised several workshops at top-tier HCI conferences, such as CHI, CSCW and UbiComp.

Garreth Tigwell is a doctoral researcher at the University of Dundee and a member of DAPRlab (Digitally-Augmented Perception Research lab). Garreth's research focuses on SIIDs when using mobile devices, and his broader interests cover many aspects of HCI such as accessibility and UX.

Zhanna Sarsenbayeva is a doctoral researcher and a member of the Interaction Design Lab at the University of Melbourne, Australia. Zhanna's research interests include ubiquitous computing, HCI, and SIIDs. In particular she is interested in how different contextual factors affect mobile interaction.

Benjamin Gorman is a Lecturer in Computer Science at Bournemouth University. Benjamin received a PhD at the University of Dundee and his research focuses on developing technology to help people with hearing loss. His doctoral research focused on solutions to enhance the acquisition of speechreading (commonly called lipreading). His knowledge of hearing loss, and how people speechread can be applied to address hearing-related SIIDs.

David Flatla is an Associate Professor at the University of Guelph (Canada) specialising in HCI and Accessibility, and is the founder of DAPRlab. David's research into supporting people with Impaired Colour Vision (ICV) has included modelling the influence of situational factors on people's colour perception abilities in a wide variety of contexts.

Jorge Goncalves is a Lecturer in the School of Computing and Information Systems at the University of Melbourne, Australia. Jorge received a PhD with distinction in Computer Science and Engineering from the University of Oulu, Finland. His research interests include ubiquitous computing, HCI, crowdsourcing, and social computing.

Yeliz Yesilada is an Associate Professor at the Middle East Technical University Northern Cyprus Campus and an Honorary Research Fellow in the School of Computer Science at the University of Manchester. Yeliz's research is focused on web accessibility and mobile web. Yeliz has experience in investigating SIIDs empirically and comparing them to problems faced by people with disabilities.

Jacob Wobbrock is a Professor of HCI at the University of Washington in Seattle, USA. Among his various research interests in HCI are accessible computing, mobile computing, and SIIDs, for which he devises quantitative studies and invents new technology solutions. He is the primary creator of Ability-Based Design, a design approach that unifies accessible computing and solutions for SIIDs.

PRE-WORKSHOP PLANS

In order to attract as many submissions as possible, we will provide all necessary information to all potentially-interested researchers as early as possible. The call will be distributed using various

Workshop Website

siid2019.wordpress.com/welcome/
The workshop website will go live before any calls for participation are sent out. The website will contain all workshop details and information, including: relevant topics for the workshop, submission and review process, email to be used for submission, important dates and program committee. The website will be updated to show accepted submissions as soon as possible in order to attract additional participants beyond the attending authors.

Workshop Schedule
09:00 - 09:10 – Welcome and Introduction.
09:10 - 10:00 – "Lightning" Presentations.
10:00 - 10:30 – Coffee break.
10:30 - 12:15 – Activity 1: Focus Groups.
12:15 - 13:15 – Lunch.
13:15 - 14:15 – Panel Discussion.
14:15 - 15:30 – Activity 2: Exploring Scenarios.
15:30 - 16:00 – Coffee break.
16:00 - 17:00 – Town Hall Meeting "Where Do We Go Next?" (*including discussion regarding collaborations and potential future events*).
19:00 – Workshop dinner.

Attendance At least one author of each accepted paper must register and attend the full-day workshop that will take place on Sunday the 5th of May, 2019. Authors will present during the workshop, but the core of the workshop is the interactive discussion of key topics regarding SIIDs. We will write a report based on the discussions and outcomes of the workshop, with the aim of creating a journal article.

channels: The workshop website (see margin), relevant HCI and Ubicomp mailing lists, the organisers' home institutions and peers, and social networks (e.g., Facebook, Twitter).

WORKSHOP STRUCTURE

The workshop will cover one full day. The organisers will begin with a short introduction, followed by a lightning presentation session (around 3-4 minutes per talk). Further instructions for the workshop lightning presentation structure are available on the workshop website. After a coffee break, we will divide attendees into groups to reflect on the previous talks and deliberate on challenges they have faced when conducting research in this domain. Post-lunch, there will be a one-hour long organiser-led panel discussion, leading into a second group activity, where we will ask participants to explore challenges of provided scenarios in terms of gaps in understanding, sensing, modelling, and adapting, in regards to the context, technology, and task. After the afternoon coffee break, we will end with a Town Hall Meeting to reflect on "Where Do We Go Next?" to identify existing research gaps, new directions for future research, and facilitate future collaborations.

POST-WORKSHOP PLANS

The summarised results of the workshop will be made available online. Further, after the workshop, the organisers will compose a journal article summarising the most prominent contributions of the accepted submissions to report on addressing SIIDs when using mobile devices.

PARTICIPANTS

We will accept around 10 papers through reviews by the workshop organisers to be presented in the workshop. In total, we expect between 15-20 attendees. Their research interests and areas of expertise are in, but not limited to, ubiquitous technologies, affective computing, accessibility, HCI.

CALLS FOR PARTICIPATION

Topics of interest

(1) Understanding – studies that help us understand the effects of SIIDs on behaviour
(2) Sensing – technologies for detecting people and environments
(3) Modelling – modelling the user or the environment
(4) Adapting – approaches for adapting interfaces using sensed data and models of the user or context to alleviate the effects of SIIDs

Submission instructions

Workshop papers are limited to a **MAXIMUM** of 8 pages (incl. references) in the SIGCHI Extended Abstract archival format. Submissions will be judged on their content not on their number of pages. Papers should be sent to the organisers at si.chiworkshop2019@gmail.com with *"Workshop submission"* as the email subject. The papers will be peer-reviewed for their significance to the overall workshop themes by the organisers of the workshop.

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