Exploring the Design Space of Assistive Augmentation

Suranga Nanayakkara*
suranga@ahlab.org
Augmented Human Lab, National University of Singapore
Singapore

Masahiko Inami
Information Somatics Laboratory, University of Tokyo
Japan
inami@star.rcast.u-tokyo.ac.jp

Florian 'Floyd' Mueller
Exertion Games Lab, Monash University, Melbourne
Australia
floyd@floydmueller.com

Jochen Huber
Furtwangen University
Germany
jochen.huber@hs-furtwangen.de

Chitralekha Gupta
Augmented Human Lab, National University of Singapore
Singapore
chitralekha@ahlab.org

Christophe Jouffrais
Centre National de la Recherche Scientifique (CNRS)
France
christophe.jouffrais@cnrs.fr

Kai Kunze
Graduate School of Media Design, Keio University
Japan
kai@kmd.keio.ac.jp

Rakesh Patibanda
rakesh@exertiongameslab.org
Exertion Games Lab, Monash University, Melbourne
Melbourne, Australia

Samantha W. T. Chan
Fluid Interfaces Group, MIT Media Lab
USA
swtchan@media.mit.edu

Moritz Alexander Messerschmidt
Augmented Human Lab, The University of Auckland
Auckland, New Zealand

ABSTRACT

Assistive Augmentation, the intersection of human-computer interaction, assistive technologies and human augmentation, was broadly discussed at the CHI'14 workshop and subsequently published as an edited volume on Springer Cognitive Science and Technology series. In this workshop, the aim is to propose a more structured way to design Assistive Augmentations. In addition, we aim to discuss the challenges and opportunities for Assistive Augmentations in light of current trends in research and technology. Participants of the workshop need to submit a short position paper or interactive system demonstration, which will be peer-reviewed. The selected position papers and demos will kick off a face-to-face discussion at the workshop. Participants will also be invited to extend the workshop discussion into a journal submission to a venue such as the Foundations and Trends in Human-Computer Interaction.

*Corresponding Author.

AHs '23, March 12–14, 2023, Glasgow, United Kingdom

ACM ISBN 978-1-4503-9984-5/23/03…$15.00
https://doi.org/10.1145/3582700.3582729

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **Accessibility**.

KEYWORDS

Augmented Human, Augmented Body, Human Computer Integration, Assistive Tech

ACM Reference Format:
Suranga Nanayakkara, Masahiko Inami, Florian 'Floyd' Mueller, Jochen Huber, Chitralekha Gupta, Christophe Jouffrais, Kai Kunze, Rakesh Patibanda, Samantha W. T. Chan, and Moritz Alexander Messerschmidt. 2023. Exploring the Design Space of Assistive Augmentation. In *Augmented Humans Conference (AHs '23), March 12–14, 2023, Glasgow, United Kingdom.* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3582700.3582729

1 INTRODUCTION

Assistive Augmentation has been proposed as *user interfaces and interactions that seamlessly integrate with a user's mind, body and behaviour, providing an enhanced perception* [9, 10]. We believe carefully designed Assistive Augmentation can empower people constrained by impairments to live more independently again and even extend one's perceptual and cognitive capabilities beyond the ordinary. However, a systematic exploration of the design space of Assistive Augmentation has not been done yet. As such, the aim of this workshop is to discuss two aspects of Assistive Augmentation forming a design space (see Figure 1 below). We will solicit two main categories of submissions: Participants will be invited to submit (1) position statements of up to 4 pages OR (2) proposals of up to 2

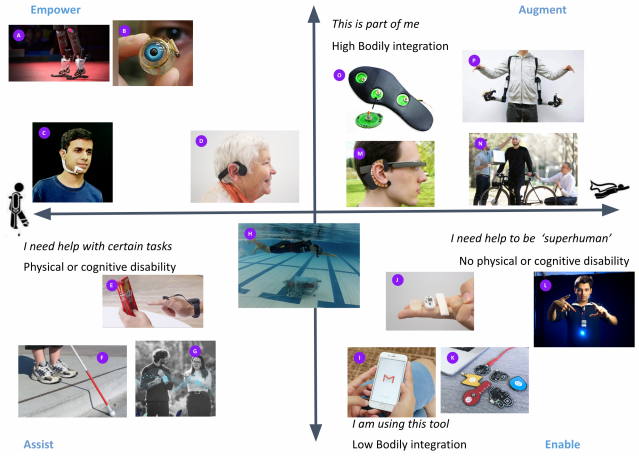

Figure 1: Design Space of Assistive Augmentation from two dimensions (ability, bodily integration) Perspective. Some examples include A) Bionic Limbs [1]; B) Retinal Implant [5]; C) AlterEgo [11]; D) Prompto [4]; E) FingerReader [14]; F) WhiteCane; G) OM [7]; H) Swimoid [16]; I) Mail app on a SmartPhone; J) ChewIt [8]; K) Kiwrious [15]; L) SixthSense [13]; M) EarPut [12]; N) Ena [2]; O) TickleFoot [6]; P) MetaArms [3].

pages describing an interactive research prototype they would like to demonstrate at the workshop.

2 CONTENT OF WORKSHOP

The workshop will consist of three components: (i) lightning talk presentations, (ii) brainstorm and discuss the design space of Assistive Augmentation and (iii) Synthesis of the discussion & plan beyond the workshop. In terms of resources, we would need a room with a few round tables to facilitate breakout discussions, a projector with standard AV system to run the lightning talks, power outlets to charge computers, flip charts, post-it notes and whiteboard markers.

3 GOALS AND OUTCOMES

The goal of the workshop is to provide a platform to brainstorm, debate and discuss the design space of Assistive Augmentation. The proceedings of the workshop will be made available via the workshop webpage (https://ah2023.ahlab.org/). Together with interested attendees, the discussion of the workshop will be extended as a journal paper. One potential target journal would be the Foundations and Trends in Human-Computer Interaction.

4 SCHEDULE

We intend to hold a full-day workshop. We expect about 10-15 position papers and demonstrations. Every position paper and demo will be given 5 minutes to present their work at the "lightning talk sessions". Organisers will present the initial 2-dimensional view of the Assistive Augmentation design space (Figure 1). This overview and the lightning talks will set the stage to further discuss the design space of Assistive Augmentation as well as challenges and opportunities. The workshop will run as follows:

- 10:00-10:10 Introduction & Welcome
- 10:15-11.30 Lightning Talks & Demos (Include a tea break of 15 mins)
- 11.30-12:00 2-dimensional view of the Assistive Augmentation design space
- 12:00-13:00 Lunch
- 13:00-15:00 Brainstorm & discussion (Include a tea break of 15 mins)
- 15:00-15.50 **Tea Break** items 15:50-16.00 Closing remarks

5 RECRUITMENT & REVIEWING

We will advertise the workshop in several research communities, including CHI, UIST, ASSETS, Augmented Humans, MobileHCI, etc via our research network. We also plan to promote the workshop through the workshop website and through social media. We expect around 20 submissions. These submissions will be reviewed by an organising committee member and discussed in a committee meeting. 15 submissions will be selected based on 1) relevance to the workshop theme; and 2) ability to foster discussion at the workshop. The total number of workshop attendees on site will be less than 20.

6 ORGANIZER BIOGRAPHIES

Suranga Nanayakkara is an Associate Professor at Department of Information Systems & Analytics, School of Computing at National University of Singapore. He founded the "Augmented Human Lab" to explore ways of designing intelligent human-computer interfaces that extend the limits of our perceptual and cognitive capabilities.

Masahiko Inami is a professor at the Research Center for Advanced Science and Technology, University of Tokyo. His research interest is in human I/O enhancement technologies/bioengineering, HCI and robotics.

Florian 'Floyd' Mueller is the director of the Exertion Games Lab and Professor of Future Interfaces at Monash University, Australia. At Exertion Games Lab, he investigates the future of bodily play, while also researching the intersection of technology, the human body and play more broadly.

Jochen Huber is Professor of Computer Science at Furtwangen University. His research investigates assistive augmentation technology that empowers people who find themselves at the edge of sensorial capability. His work finds its application in mobile, healthcare and automotive.

Chitralekha Gupta is a Post-Doctoral Research Fellow at the National University of Singapore (NUS). She founded a music tech company, MuSigPro, in Singapore in 2019. Her research interests are in the areas of music information retrieval, audio synthesis, and assistive technologies.

Christophe Jouffrais is a CNRS researcher with a background in cognitive Neuroscience and Assistive Technology. His current research focuses on blind human perception, action and cognition with an emphasis on non-visual Human-Computer Interactions, Assistive Technologies for the Blind, and simulation of visual neuroprosthesis.

Kai Kunze is a Professor at the Graduate School of Media Design, Keio University. He has over fifteen years of experience in the Wearable Computing and serves as the co-chair of the International Wearable Computing Academic Research Community.

Rakesh Patibanda is a third-year PhD candidate at the Exertion Games Lab, Monash University. His PhD focuses on how humans share bodily control with body-actuating technologies like Electrical Muscle Stimulation (EMS) to experience their body as an output display for spectating and playing games.

Samantha Chan is a Postdoctoral fellow at the Fluid Interfaces Group, MIT Media Lab. She is researching on novel technologies that enhance human memory and cognition to advance human potential.

Moritz Alexander Messerschmidt is a PhD candidate at the Augmented Human Lab at the University of Auckland. He is working towards his vision of a more intuitive and effective augmentation of our sense of touch by providing haptic feedback through unobtrusive wearable interfaces directly on the human body.

REFERENCES

[1] 2018. The new bionics that let us run, climb and dance. https://www.ted.com/talks/hugh_herr_the_new_bionics_that_let_us_run_climb_and_dance

[2] Josh Andres, m.c. schraefel, Nathan Semertzidis, Brahmi Dwivedi, Yutika C. Kulwe, Juerg von Kaenel, and Florian Floyd Mueller. 2020. Introducing Peripheral Awareness as a Neurological State for Human-Computer Integration. In *CHI '20*. ACM, New York, NY, USA, 1–13.

[3] Josh Andres, m.c. schraefel, Nathan Semertzidis, Brahmi Dwivedi, Yutika C. Kulwe, Juerg von Kaenel, and Florian Floyd Mueller. 2020. Introducing Peripheral Awareness as a Neurological State for Human-Computer Integration. In *CHI '20*. ACM, New York, NY, USA, 1–13.

[4] Samantha W. T. Chan, Shardul Sapkota, Rebecca Mathews, Haimo Zhang, and Suranga Nanayakkara. 2020. Prompto: Investigating Receptivity to Prompts Based on Cognitive Load from Memory Training Conversational Agent. *IMWUT* 4, 4, Article 121 (2020), 23 pages.

[5] Thomas L Edwards, Charles L Cottriall, Kanmin Xue, Matthew P Simunovic, James D Ramsden, Eberhart Zrenner, and Robert E MacLaren. 2018. Assessment of the electronic retinal implant alpha AMS in restoring vision to blind patients with end-stage retinitis pigmentosa. *Ophthalmology* 125, 3 (2018), 432–443.

[6] Don Samitha Elvitigala, Roger Boldu, Suranga Nanayakkara, and Denys J. C. Matthies. 2022. TickleFoot: Design, Development and Evaluation of a Novel Foot-Tickling Mechanism That Can Evoke Laughter. *ACM Trans. Comput.-Hum. Interact.* 29, 3, Article 20 (jan 2022), 23 pages.

[7] Juan Pablo Forero Cortes, Hussel Suriyaarachchi, Alaeddin Nassani, Haimo Zhang, and Suranga Nanayakkara. 2021. OM: A Comprehensive Tool to Elicit Subjective Vibrotactile Expressions Associated with Contextualised Meaning in Our Everyday Lives. In *MobileHCI '21*. ACM, Article 6, 12 pages.

[8] Pablo Gallego Cascón, Denys J.C. Matthies, Sachith Muthukumarana, and Suranga Nanayakkara. 2019. ChewIt. An Intraoral Interface for Discreet Interactions. In *CHI '19*. ACM, 1–13.

[9] Jochen Huber, Jun Rekimoto, Masahiko Inami, Roy Shilkrot, Pattie Maes, Wong Meng Ee, Graham Pullin, and Suranga Nanayakkara. 2014. Workshop on Assistive Augmentation. In *CHI EA '14*. ACM, New York, NY, USA, 103–106.

[10] Jochen Huber, Roy Shilkrot, Pattie Maes, and Suranga Nanayakkara. 2018. *Assistive augmentation*. Springer.

[11] Arnav Kapur, Shreyas Kapur, and Pattie Maes. 2018. AlterEgo: A Personalized Wearable Silent Speech Interface. ACM, New York, NY, USA, 43–53.

[12] Roman Lissermann, Jochen Huber, Aristotelis Hadjakos, Suranga Nanayakkara, and Max Mühlhäuser. 2014. EarPut: Augmenting Ear-Worn Devices for Ear-Based Interaction. In *OzCHI '14*. ACM, 300–307.

[13] Pranav Mistry and Pattie Maes. 2009. SixthSense: A Wearable Gestural Interface. In *SIGGRAPH ASIA '09*. ACM, New York, NY, USA, 85.

[14] Roy Shilkrot, Jochen Huber, Wong Meng Ee, Pattie Maes, and Suranga Chandima Nanayakkara. 2015. FingerReader: A Wearable Device to Explore Printed Text on the Go. In *CHI '15*. ACM, 2363–2372.

[15] Hussel Suriyaarachchi, Paul Denny, and Suranga Nanayakkara. 2022. Scratch and Sense: Using Real-Time Sensor Data to Motivate Students Learning Scratch. In *SIGCSE 2022* (Providence, RI, USA) *(SIGCSE 2022)*. ACM, 983–989.

[16] Yu Ukai and Jun Rekimoto. 2013. Swimoid: A Swim Support System Using an Underwater Buddy Robot. In *AH '13*. ACM, New York, NY, USA, 170–177.