Haimo ZHANG

HCI researcher, PhD in computer science

Bioengineering Institute, University of Auckland,
Room 439.513, Level 5, 70 Symonds Street,
Grafton, Auckland 1010, New Zealand

https://haimoz.github.io/
haimoz@acm.org

RESEARCH INTEREST

I am a researcher in human-computer interaction. I specifically focus on enhancing human capabilities and experiences — perceptions, cognitions, and actions — when interacting with the physical surroundings. The grand challenge in my research is to create intuitive and transparent technologies as natural extensions of our body, instead of as external tools.

RECENT RESEARCH HIGHLIGHTS

Perception - Novel Haptic Feedback with Hair Stimulation

We invented a method to only stimulate the hair without actuating the skin, which is a novel and unique haptic sensation that suggests interesting design opportunities such as subtle notifications, and eliciting and communicating emotions. The method involves application of an off-the-shelf cosmetic (containing iron particles) onto the hair and actuating it with a moving magnetic field. The initial implementation used a permanent magnet attached to a 2D CNC router. Our current work (in review) focuses on the development of a wearable implementation.

Action - Touch Sensing on Any Object

In the first of this series of projects, we enabled touch interaction on individual keycaps of a physical keyboard. This allowed for simultaneous keystroke and gesture input, which allowed for novel interactions, such as intuitive text entry for characters with accents.

In the second project, we enabled touch interaction on a rigid flat surface, using active acoustic localization methods. This essentially transforms any surface into a trackpad with an ad-hoc setup. The system also opportunistically supports tactile feedback and pseudo force input.

Our latest project (journal article to appear) utilizes a finger-mounted motion sensor for robust touch sensing on ordinary objects, such as wooden table, fabrics, and human body.

Cognition - Memory Support Systems

We adapted a memory training technique (the "when-then" technique) from its conventional face-to-face format to a digital form, as an app. A 12-day in situ study validated the effectiveness of the app for elderly users, making this memory training technique more scalable and accessible to elderly users.

A follow-up research investigated the potential of leveraging users' physiological signals (e.g., heart rate, skin conductance, etc.) as cues to prompt for such memory trainings.

Our current work (in review) tests whether users are more likely to respond to such prompts when they are having low cognitive load.

PROFESSIONAL EXPERIENCE

Auckland, New Zealand, Feb 2020 ~ present

Lecturer
Faculty of Creative Arts and Industries
The University of Auckland

Auckland, New Zealand, March 2018 ~ present

Research Fellow
Auckland Bioengineering Institute
The University of Auckland

Singapore, June 2016 ~ March 2018

Postdoctoral Research Fellow
Singapore University of Technology and Design

Adelaide, Australia, May 2017 ~ July 2017

Visiting Scholar
University of South Australia

Singapore, September 2015 ~ June 2016

Data Scientist
3ELogic Consultancy Pte. Ltd.

Gothenburg, Sweden, June 2015 ~ July 2015

Visiting Postdoctoral Researcher
Chalmers University of Technology

Mountain View, United States, May 2013 ~ August 2013

Software Engineering Intern

Google Inc.

Beijing, China, May 2011 ~ October 2011 **Research Intern**
HCI group
Microsoft Research Asia

Singapore, May 2008 ~ July 2008 **Software Engineering Intern**
IBM

EDUCATION

August 2009 ~ Jan 2015 **National University of Singapore,** PhD in Computer
Science (Human-Computer Interaction)

August 2005 ~ June 2009 **National University of Singapore,** Bachelor of Computer
Engineering (Hons.)

TOOLS & SKILLS

Design
- **User-Centred Design:** empathy building, brainstorming, storyboarding, iterative process
- **CAD:** InkScape, LibreCAD, OpenSCAD

Build
- **Programming:** Python, C, JavaScript, Java, C++
- **Web technologies:** Flask, Node.js, D3.js, Sass/CSS, HTML
- **Scientific computing:** Jupyter Notebooks, R/RStudio, SciPy, Octave/MATLAB
- **OS:** Linux
- **Version control:** Git
- **Electronics:** Arduino, IMUs, simple PCB design
- **Manufacturing:** laser cutting, sewing machines, 3D printing
- **Low-Fidelity Prototyping:** InVision, PPT, paper prototypes

Test
- Controlled experiments and statistical testings (t-Tests, ANOVA, Wilcoxon Signed-Rank Tests, etc.), using R
- Fitts' Law studies (ISO 9241-9 compliant)
- Psychophysics experiments
- Eye tracking studies
- User studies using E4 Empatica wristband (heart rate, skin conductance, temperature)

Communication & Documentation
- Technical writing and presentation
- **Documentation tools:** Markdown, LaTeX, Jekyll
- **Collaboration tools:** Trello, Miro, Slack

ACADEMIC SERVICES
- Associate Chair for the ACM CHI Conference on Human Factors in Computing Systems (CHI), 2020, 2019, 2015.
- Associate Chair for the International Conference on Human-Computer Interactions with Mobile Devices and Services (MobileHCI), 2020.
- Program committee member for Augmented Humans conference (AH), 2020.
- Program Co-Chair for Augmented Human conference (AH), 2019.

PEER-REVIEWED PUBLICATIONS

Conference Papers

C1. Roger Boldu, Meva Wijewardena, Haimo Zhang, and Suranga Nanayakkara. 2020. MAGHair: A Wearable System to Create Unique Tactile Feedback by Stimulating Only the Body Hair. In *Proceedings of the 22th international conference on human-computer interaction with mobile devices and services* (MobileHCI '20). *To appear*.

C2. Yilei Shi, Haimo Zhang, Jiashuo Cao, Suranga Nanayakkara. 2020. VersaTouch: A Versatile Plug-and-Play System that Enables Touch Interactions on Everyday Passive Surfaces. In *Augmented Humans International Conference (AH 2020), March 16–17, 2020, Kaiserslautern, Germany*. ACM, New York, NY, USA, 12 pages. *To appear.*

C3. Roger Boldu, Sambhav Jain, Juan Pablo Forero Cortes, Haimo Zhang, and Suranga Nanayakkara. 2019. M-Hair: Creating Novel Tactile Feedback by Augmenting the Body Hair to Respond to Magnetic Field. In *Proceedings of the 32Nd Annual ACM Symposium on User Interface Software and Technology* (UIST '19), 323–328.
https://doi.org/10.1145/3332165.3347955

C4. Thisum Buddhika, Haimo Zhang, Samantha W. T. Chan, Vipula Dissanayake, Suranga Nanayakkara, and Roger Zimmermann. 2019. fSense: Unlocking the Dimension of Force for Gestural Interactions Using Smartwatch PPG Sensor. In *Proceedings of the 10th Augmented Human International Conference 2019* (AH2019), 11:1–11:5.

C5. Thisum Buddhika, Haimo Zhang, Chamod Weerasinghe, Suranga Nanayakkara, and Roger Zimmermann. 2019. OSense: Object-activity Identification Based on Gasping Posture and Motion. In *Proceedings of the 10th Augmented Human International Conference 2019* (AH2019), 13:1–13:5. https://doi.org/10.1145/3311823.3311841

C6. Samantha W. T. Chan, Haimo Zhang, and Suranga Nanayakkara. 2019. Prospero: A Personal Wearable Memory Coach. In *Proceedings of the 10th Augmented Human International Conference 2019* (AH2019), 26:1–26:5. https://doi.org/10.1145/3311823.3311870

C7. Vipula Dissanayake, Don Samitha Elvitigala, Haimo Zhang, Chamod Weerasinghe, and Suranga Nanayakkara. 2019. CompRate: Power Efficient Heart Rate and Heart Rate Variability Monitoring on Smart Wearables. In *25th ACM Symposium on Virtual Reality Software and Technology* (VRST '19), 16:1–16:8. https://doi.org/10.1145/3359996.3364239

C8. Yilei Shi, Haimo Zhang, Hasitha Rajapakse, Nuwan Tharaka Perera, Tomás Vega Gálvez, and Suranga Nanayakkara. 2018. GestAKey: Touch Interaction on Individual Keycaps. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (CHI '18), 596:1–596:12. https://doi.org/10.1145/3173574.3174170

C9. Sumbul Khan, Hasitha Rajapakse, Haimo Zhang, Suranga Nanayakkara, Bige Tuncer, and Lucienne Blessing. 2017. GesCAD: An Intuitive Interface for Conceptual Architectural Design. In *Proceedings of the 29th Australian Conference on Computer-Human Interaction* (OZCHI '17), 402–406. https://doi.org/10.1145/3152771.3156145

C10. Roger Boldu, Haimo Zhang, Juan Pablo Forero Cortés, Sachith Muthukumarana, and Suranga Nanayakkara. 2017. InSight: A Systematic Approach to Create Dynamic Human-Controller-Interactions. In *The 8th Augmented Human International Conference*.

C11. Haimo Zhang and Yang Li. 2014. GestKeyboard: enabling gesture-based interaction on ordinary physical keyboard. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems*, 1675–1684.

C12. Seokhwan Kim, Xiang Cao, Haimo Zhang, and Desney Tan. 2012. Enabling concurrent dual views on common LCD screens. In *proceedings of the SIGCHI conference on human factors in computing systems*, 2175–2184.

C13. Haimo Zhang, Xiang Cao, and Shengdong Zhao. 2012. Beyond stereo: an exploration of unconventional binocular presentation for novel visual experience. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2523–2526.

C14. Haimo Zhang and Shengdong Zhao. 2011. Measuring web page revisitation in tabbed browsing. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1831–1834.

Journal Articles

J1. Yilei Shi, Haimo Zhang, Kaixing Zhao, Jiashuo Cao, Mengmeng Sun, and Suranga Nanayakkara. 2020. Ready, Steady, Touch! — Sensing Physical Contact with a Finger-Mounted IMU. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol. To appear.*

J2. Samantha W. T. Chan, Thisum Buddhika, Haimo Zhang, and Suranga Nanayakkara. 2019. ProspecFit: In Situ Evaluation of Digital Prospective Memory Training for Older Adults. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 3, 3: 77:1–77:20. https://doi.org/10.1145/3351235

J3. Soon Hau Chua, Haimo Zhang, Muhammad Hammad, Shengdong Zhao, Sahil Goyal, and Karan Singh. 2015. Colorbless: augmenting visual information for colorblind people with binocular luster effect. *ACM Transactions on Computer-Human Interaction (TOCHI)* 21, 6: 32.

J4. Yang Li, Hao Lu, and Haimo Zhang. 2014. Optimistic programming of touch interaction. *ACM Transactions on Computer-Human Interaction (TOCHI)* 21, 4: 24.

J5. Xiaole Kuang, Haimo Zhang, Shengdong Zhao, and Michael J. McGuffin. 2012. Tracing Tuples Across Dimensions: A Comparison of Scatterplots and Parallel Coordinate Plots. *Computer Graphics Forum* 31, 3pt4: 1365–1374. https://doi.org/10.1111/j.1467-8659.2012.03129.x

Others (Posters / Demos / Videos)

O1. Roger Boldu, Sambhav Jain, Juan Pablo Forero Cortes, Haimo Zhang, and Suranga Nanayakkara. 2019. M-Hair: Extended Reality by Stimulating the Body Hair. In *SIGGRAPH Asia 2019 XR* (SA '19), 27–28. https://doi.org/10.1145/3355355.3361881

O2. Yvonne Chua, Priyashri Kamlesh Sridhar, Haimo Zhang, Vipula Dissanayake, and Suranga Nanayakkara. 2019. Evaluating IVR in Primary School Classrooms. In *2019 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)*, 169–174. https://doi.org/10.1109/ISMAR-Adjunct.2019.00-53

O3. Yilei Shi, Tomás Vega Gálvez, Haimo Zhang, and Suranga Nanayakkara. 2017. GestAKey: Get More Done with Just-a-Key on a Keyboard. In *Adjunct Publication of the 30th Annual ACM Symposium on User Interface Software and Technology* (UIST '17), 73–75. https://doi.org/10.1145/3131785.3131786

O4. Haimo Zhang, Yang Li. *GestKeyboard: Enabling Gesture-Based Interaction on Ordinary Physical Keyboard.* CHI EA (Video Showcase) 2014.

O5. Haimo Zhang, Xiang Cao, Shengdong Zhao. *Beyond Stereo: An Exploration of Unconventional Binocular Presentation for Novel Visual Experience*. CHI EA (Interactivity) 2012.

O6. Seokhwan Kim, Xiang Cao, Haimo Zhang, Desney Tan. *Enabling Concurrent Dual Views on Common LCD Screens*. CHI EA (Interactivity) 2012.

OTHER FORMS OF DISSEMINATION

Exhibitions / Installations

E1. *LightTank*, Exhibition at Ars Electronica, as a contributor for the touch tracking solution, 10 September, 2018.
E2. *Da Vinci: Shaping the Future*, Exhibition at Singapore ArtScience Museum, 15 November, 2014 - May, 2015.
E3. *Sunday Showcase* Exhibition at Singapore ArtScience Museum, 2013 & 2014.

Workshops
W1. Design Workshop (2019), The University of Auckland, New Zealand.
W2. Design Thinking Workshop (2018), The University of Auckland, New Zealand.
     https://www.youtube.com/watch?v=rREnJz5nYg8
W3. Design Thinking Workshop (2017), Sri Lanka.

AWARDS & DISTINCTIONS
A1. Fast Company World Changing Ideas Honorable Mention Award (2020) - M-Hair
A2. Velocity Innovation Challenge Award (2019)
A3. SMART (Singapore-MIT Alliance for Research and Technology) Innovation Fellow (2017)
A4. AH Conference Best Paper (2017)
A5. Dean's Graduate Research Excellence Award (2012)
A6. CHI Conference Best Note Honorable Mention (2012)
A7. Dean's List (2006)

TEACHING
- Jul 2020 ~ Nov 2020: **DESIGN 243: Design and Assistive Technologies**, Faculty of Creative Arts and Industries, The University of Auckland.
- Mar 2020 ~ Jun 2020: **DESIGN 100: How We Design**, Faculty of Creative Arts and Industries, The University of Auckland.
- Jan 2013 ~ Apr 2013: **CS3240: Interaction Design**, School of Computing, National University of Singapore. Teaching Assistant.
- 2012 ~ 2013: **CS3283/CS3284: Media Technology Projects I/II**, School of Computing, National University of Singapore. Project team supervisor.
- 11 Feb 2010: **CS3248: Design of Interactive Systems**, School of Computing, National University of Singapore. Guest lecturer.

SUPERVISION
(*all co-supervised*)
In progress:
- Moritz Alexander Messerschmidt, "Mobile Haptic Feedback", PhD 2020~2023.
- Vipula Dissanayake, "Speech Emotion Recognition", PhD 2019~2022.
- Roger Boldu, "Accessing Information On-The-Go", PhD 2018~2021.
- Samantha Chan, "Memory Support Technologies for Elderly", PhD 2018~2021.
- Juan Pablo Forero Cortes, "Wrist-worn Vibrotactile Interface for Hearing Impaired", MSc. 2018~2020.
- Yilei Shi, "Enabling Touch of Any Object", PhD 2016~2020, thesis submitted.

Completed:
- Vipula Dissanayake, "Heart Rate Estimation on Smartwatches", MSc. 2018~2019.
- Yvonne Chua, "Immersive Virtual Reality for Classroom", MSc. 2018~2019.

PATENTS
P1. Xiang Cao, Haimo Zhang. (2012). User perception of visual effects. U.S. patent publication on 2013-11-07. Abandoned due to inventors leaving the company.
P2. Xiang Cao, Seokhwan Kim, Haimo Zhang, Desney S. Tan. (2012). Simultaneous display of multiple content items. Patent pending in multiple countries.

GRANTS
G1. Design and Develop a Tool to Support In-situ Language Learning for Children with Dyslexia (2 years, ~USD 488,000), as Co-PI.
G2. Project Kiwrious: Activating Curious and Fearless Problem Solvers (11 months, ~USD 93,274), as Co-Investigator.

REFERENCES
Available upon request.