

Robert Xiao

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EDUCATION

PhD in Human-Computer Interaction **2011 – 2018**

Carnegie Mellon University, Pittsburgh, PA

Thesis Defended: May 30, 2018

On-World Computing: Unleashing Computation on the World Around Us

Bachelor of Mathematics **2007 – 2011**

University of Waterloo, Waterloo, ON

Double Honours in Computer Science and Combinatorics & Optimization

POSITIONS AND APPOINTMENTS HELD

Assistant Professor, University of British Columbia **2019 – Present**

Assistant Professor in the Department of Computer Science.

Vancouver, BC, Canada

Research Consultant, Microsoft Research **2017**

Mentored by Julia Schwarz and Hrvoje Benko. Work focused on advancing interactions in augmented reality.

Redmond, WA, USA

Research Intern, Microsoft Research **2016**

Mentored by Andy Wilson and Hrvoje Benko. Work focused on advancing interactions in augmented reality.

Redmond, WA, USA

Research Intern, Microsoft Research **2015**

Mentored by Andy Wilson. Work focused on expanding the FoV of VR systems using sparse peripheral displays. Work resulted in the Sparse Peripheral Displays paper, which earned an honorable mention at CHI 2016.

Redmond, WA, USA

Software Architect, Qeexo, Co.	2013
Summer internship with CMU spinoff. Work focused on engineering rich multitouch solutions for mobile devices. Pittsburgh, PA, USA	
Research Intern, Microsoft Research	2012
Mentored by John Tang. Work focused on in-home physical proxies for video communication. HomeProxy publication resulted from this internship. Redmond, WA, USA	
Embedded Software Developer, Research in Motion	2011
Development and validation of embedded radio firmware for 3G modems. Waterloo, ON, Canada	
Summer Research Student, University of Saskatchewan	2010
Summer research with the Interaction Lab, Department of Computer Science, mentored by Carl Gutwin. Research funded by NSERC under the Undergraduate Student Research Award program. Saskatoon, SK, Canada	
Summer Research Student, University of Saskatchewan	2009
Summer research with the Interaction Lab, Department of Computer Science, mentored by Regan Mandryk and Carl Gutwin. Research funded by NSERC under the Undergraduate Student Research Award program. Saskatoon, SK, Canada	
Summer Research Student, University of Saskatchewan	2008
Summer research with the Imaging, Multimedia and Graphics Lab, Department of Computer Science, mentored by Mark Eramian. Research funded by NSERC under the Undergraduate Student Research Award program. Saskatoon, SK, Canada	
Database Analyst, University of Saskatchewan	2007
Database analyst with the Centre for Continuing and Distance Education at the University of Saskatchewan. Saskatoon, SK, Canada	

HONOURS AND AWARDS

FUNDING

MITACS Canada Accelerate Grant	2023 – 2024
\$30,000 project grant in partnership with Rogers Canada.	

Rogers 5G Partnership Grant	2023 – 2024
\$45,000 project grant for one year, provided by Rogers Canada as an extension of the prior project	
DND/CAF Innovation for Defence Excellence and Security	2022 – 2025
\$1,500,000 over three years for “Situational-aware and Adaptive 5G Networks for Defence and Security”. Co-applicant with Vincent Wong (UBC), Lin Cai (UVic), Long Bao Le (INRS), Ben Liang (UToronto), and Karthik Pattabiraman (UBC). Provided by the Department of National Defence and the Canadian Armed Forces through a competitive application process.	
Adobe Research Gift	2022
\$20,000 unrestricted gift funding provided through collaboration with Adobe researchers working on VR interaction research.	
NSERC Research Tools and Instruments	2021 – 2022
\$89,838 for one year for non-optical motion tracking equipment; co-applicant with Dinesh K. Pai (PI), Helge Rhodin, and Kwang Moo Yi. Provided by the National Science and Engineering Research Council through a competitive application process	
NSERC Discovery Launch Supplement	2019 – 2024
\$12,500 award for exceptional Early Career Researchers provided as a supplement to the Discovery Grant	
NSERC Discovery Grant	2019 – 2024
\$195,000 over five years (\$39,000 per year) provided by the National Science and Engineering Research Council through a competitive application process	
Rogers 5G Partnership Grant	2019 – 2022
\$289,800 project grant for three years, provided by Rogers Canada for research in AR/VR interactions through a competitive granting process.	
SCHOLARSHIPS & FELLOWSHIPS	
NSERC Postgraduate Scholarship	2013 – 2015
\$63,000 award for three years, awarded to top Canadian graduates in their third year of a graduate program of study	
Qualcomm Innovation Fellowship	2012
\$100,000 award for one year for a team of two students	
NSERC Julie Payette Postgraduate Scholarship	2011
\$25,000 award for one year awarded to top Canadian students in their first year of a graduate program of study	

NSERC Undergraduate Student Research Award 2008 – 2010
Canadian federal fellowships to support academic research as an undergraduate student

Rene Descartes Scholarship 2007 – 2011
Awarded to students with strong performance on Canadian national mathematics competitions

SELECTED HONOURS AND AWARDS

SIGCHI Outstanding Dissertation Award 2019
Awarded for the most outstanding dissertations within the HCI community.

Fast Company Innovation by Design Experimental Finalist 2018
Awarded for LumiWatch, recognizing an outstanding work of innovation. LumiWatch also earned an Honorable Mention in the Student category.

Fast Company Innovation by Design Student Award 2016
Awarded for EM-Sense, recognizing an outstanding work of innovation. A total of 15 awards were given out from a pool of 1700 nominations

Allen Newell Award for Research Excellence 2015
Awarded w/ Scott Hudson to recognize outstanding body of work within the School of Computer Science at Carnegie Mellon University

Governor General's Silver Medal 2011
Awarded to the individual with the highest academic average over all graduating students

Rising Stars of Research Honourable Mention 2010
Awarded to outstanding posters in the national Rising Stars of Research Poster Competition

NSERC USRA Poster Competition First Prize 2009, 2010
Awarded to the top poster presented at the University of Saskatchewan USRA Poster Fair



Putnam Mathematics Competition 2008
110th place in North America (4th in U of Waterloo)




President's Scholarship of Distinction 2007
Awarded to students with a 95% entrance average or higher

PUBLICATIONS


44. Yin, M. and **Xiao, R.** (2024). Press A or Wave: User Expectations for NPC Interactions and Nonverbal Behaviour in Virtual Reality. To appear in CHI PLAY 2024. ACM, New York, NY, USA. 18 pages.
43. Yin, M. and **Xiao, R.** (2024). How We See Changes How We Feel: Investigating the Effect of Visual Point-of-View on Decision-Making in VR Environments. To appear in Proceedings of the 27th ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW '24). ACM, New York, NY, USA. 23 pages.
42. Yin, M. and **Xiao, R.** (2024). Lies, Deceit, and Hallucinations: Player Perception and Expectations Regarding Trust and Deception in Games. To appear in Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). ACM, New York, NY, USA. 16 pages.
41. Huang, X. and **Xiao, R.** (2024). SurfShare: Lightweight Spatially Consistent Physical Surface and Virtual Replica Sharing with Head-mounted Mixed-Reality. In *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT '24)*, Vol. 7, Iss. 4. ACM, New York, NY, USA. 19 pages. DOI: <https://doi.org/10.1145/3631418>.
40. Sayara, A., Chen, E. L., Nguyen, C., **Xiao, R.** and Yoon, D. (2023). GestureCanvas: Prototyping Compound Freehand Interaction in VR through Programming by Demonstration. In *Proceedings of the 36th Annual Symposium on User Interface Software & Technology (UIST '23)*. ACM, New York, NY, USA. 16 pages. DOI: <https://doi.org/10.1145/3586183.3606736>.
39. Huang, X., Riddell, J. and **Xiao, R.** (2023). Virtual Reality Telepresence: 360-Degree Video Streaming with Edge-Compute Assisted Foveated Compression. In *Proceedings of the 2023 International Symposium on Mixed and Augmented Reality (ISMAR '23)*. 9 pages. DOI: <https://doi.org/10.1109/tvcg.2023.3320255>.
38. Yin, M. and **Xiao, R.** (2023). Drifting Off in Paradise: Why People Sleep in Virtual Reality. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. ACM, New York, NY, USA. 13 pages. DOI: <https://doi.org/10.1145/3544548.3580947>.
37. Xu, N. X. and **Xiao, R.** (2022). Reducing the Latency of Touch Tracking on Ad-hoc Surfaces. In *Proceedings of the ACM on Human-Computer Interaction, Interactive Surfaces and Spaces (ISS '22)*. ACM, New York, NY, USA. Article 577 (December 2022), 16 pages. DOI: <https://doi.org/10.1145/3567730>.

36. Yin, M. and **Xiao, R.** (2022). How Should I Respond to “Good Morning?”: Understanding Choice in Narrative-Rich Games. In *Proceedings of the 2022 Designing Interactive Systems Conference (DIS '22)*. ACM, New York, NY, USA. 16 pages. DOI: <https://doi.org/10.1145/3532106.3533459>. **Honourable Mention Award.**
35. Yin, M. and **Xiao, R.** (2022). The Reward for Luck: Understanding the Effect of Random Reward Mechanisms in Video Games on Player Experience. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22)*. ACM, New York, NY, USA. 12 pages. DOI: <https://doi.org/10.1145/3491102.3517642>
34. Straubinger, T., **Xiao, R.** and Rhodin, H. (2022). Learned Acoustic Reconstruction Using Synthetic Aperture Focusing. In *Proceedings of the 2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP '22)*. Institute of Electrical and Electronics Engineers. 4 pages. DOI: <https://doi.org/10.1109/ICASSP43922.2022.9746645>
33. Unlu, A. E. and **Xiao, R.** (2021). PAIR: Phone as an Augmented Immersive Reality Controller. In *Proceedings of the 27th ACM Symposium on Virtual Reality Software and Technology (VRST '21)*. Association for Computing Machinery, New York, NY, USA, Article 27, 1–6. DOI: <https://doi.org/10.1145/3489849.3489878>
32. Shakeri, H., Elbaggari, H., Bucci, P., **Xiao, R.** and MacLean, K.E. (2021). FoldMold: Automating Papercraft for Fast DIY Casting of Scalable Curved Shapes. In *Proceedings of Graphics Interface '21*. 10 pages. DOI: <https://doi.org/10.20380/GI2021.10>.
31. **Xiao, R.**, Mayer, S. and Harrison, C. (2020). VibroComm: Using Commodity Gyroscopes for Vibroacoustic Data Reception. In *Proceedings of the 22nd International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '20)*. ACM, New York, NY, USA. Article 5, 1–9. DOI: <https://doi.org/10.1145/3379503.340354>.
30. Kianzad, S., Huang, Y., **Xiao, R.** and MacLean, K.E. (2020). Phasking on Paper: Accessing a Continuum of Physically Assisted SKetchING. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. ACM, New York, NY, USA. 12 pages. DOI: <https://doi.org/10.1145/3313831.3376134>.
Honourable Mention Award
29. Ahuja, K., Pareddy, S., **Xiao, R.**, Goel, M. and Harrison, C. (2019). LightAnchors: Appropriating Point Lights for Spatially-Anchored Augmented Reality Interfaces. In *Proceedings of the 32nd Annual Symposium on User Interface Software & Technology (UIST '19)*. ACM, New York, NY, USA. 189-196.
DOI: <https://doi.org/10.1145/3332165.3347884>

28.  Ahuja, K., Harrison, C., Goel, M. and **Xiao, R.** (2019). MeCap: Whole-Body Digitization for Low-Cost VR/AR Headsets. In *Proceedings of the 32nd Annual Symposium on User Interface Software & Technology (UIST '19)*. ACM, New York, NY, USA. 453-462. DOI: <https://doi.org/10.1145/3332165.3347889>. **Honourable Mention Award**
27. **Xiao, R.**, Cao, T., Guo, N., Zhuo, J., Zhang, Y. and Harrison, C. (2018). LumiWatch: On-Arm Projected Graphics and Touch Input. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. Paper 95, 11 pages. DOI: <https://doi.org/10.1145/3173574.3173669>
26. **Xiao, R.**, Schwarz, J., Throm, N., Wilson, A. and Benko, H. (2018). MRTouch: Adding Touch Input to Head-Mounted Mixed Reality. In *IEEE Transactions on Visualization and Computer Graphics (TVCG) Special Issue, Volume 24, Number 4*, 1653-1660. DOI: <https://doi.org/10.1109/TVCG.2018.2794222>
25. **Xiao, R.**, Hudson, S.E. and Harrison, C. (2017). Supporting Responsive Cohabitation Between Virtual Interfaces and Physical Objects on Everyday Surfaces. In *Proceedings of the ACM on Human-Computer Interaction, Engineering Interactive Computing Systems (EICS '17)*. ACM, New York, NY, USA. Article 12. 17 pages. DOI: <https://doi.org/10.1145/3095814>
24. **Xiao, R.**, Laput, G., Zhang, Y. and Harrison, C. (2017). Deus EM Machina: On-Touch Contextual Functionality for Smart IoT Appliances. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 4000-4008. DOI: <https://doi.org/10.1145/3025453.3025828>
23. **Xiao, R.**, Hudson, S.E. and Harrison, C. (2016). CapCam: Enabling Quick, Ad-Hoc, Position-Tracked Interactions Between Devices. In *Proceedings of the 2016 International Conference on Interactive Surfaces & Spaces (ISS '16)*. ACM, New York, NY, USA, 169-178. DOI: <https://doi.org/10.1145/2992154.2992182>
22. **Xiao, R.**, Hudson, S.E. and Harrison, C. (2016). DIRECT: Making Touch Tracking on Ordinary Surfaces Practical with Hybrid Depth-Infrared Sensing. In *Proceedings of the 2016 International Conference on Interactive Surfaces & Spaces (ISS '16)*. ACM, New York, NY, USA, 85-94. DOI: <https://doi.org/10.1145/2992154.2992173>
21.  Laput, G., **Xiao, R.** and Harrison, C. (2016). ViBand: High-Fidelity Bio-Acoustic Sensing Using Commodity Smartwatch Accelerometers. In *Proceedings of the 29th Annual Symposium on User Interface Software & Technology (UIST '16)*. ACM, New York, NY, USA, 321-333. DOI: <https://doi.org/10.1145/2984511.2984582>. **Best Paper Award**

20. Zhang, Y., **Xiao, R.** and Harrison, C. (2016). Advancing Hand Gesture Recognition with High Resolution Electrical Impedance Tomography. In *Proceedings of the 29th Annual Symposium on User Interface Software & Technology (UIST '16)*. ACM, New York, NY, USA, 843-850. DOI: <https://doi.org/10.1145/2984511.2984574>
19.  **Xiao, R.**, Benko, H. Augmenting the Field-of-View of Head-Mounted Displays with Sparse Peripheral Displays. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 1221-1232. DOI: <https://doi.org/10.1145/2858036.2858212>. **Honourable Mention Award**
18. **Xiao, R.**, Schwarz, J. and Harrison, C. (2015). Estimating 3D Finger Angle on Commodity Touchscreens. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces (ITS '15)*. ACM, New York, NY, USA, 47-50. DOI: <https://doi.org/10.1145/2817721.2817737>
17. Guo, A., **Xiao, R.** and Harrison, C. (2015). CapAuth: Identifying and Differentiating User Handprints on Commodity Capacitive Touchscreens. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces (ITS '15)*. ACM, New York, NY, USA, 59-62. DOI: <https://doi.org/10.1145/2817721.2817722>
16.  Chatterjee, I., **Xiao, R.** and Harrison, C. (2015). Gaze+Gesture: Expressive, Precise and Targeted Free-Space Interactions. In *Proceedings of the 2015 International Conference on Multimodal Interaction (ICMI '15)*. ACM, New York, NY, USA, 131-138. DOI: <http://dx.doi.org/10.1145/2818346.2820752>. **Best Paper Award**
15.  Laput, G., Yang, C., **Xiao, R.**, Sample, A. and Harrison, C. (2015). EM-Sense: Touch Recognition of Uninstrumented, Electrical and Electromechanical Objects. In *Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology (UIST '15)*. ACM, New York, NY, USA, 157-166. DOI: <https://doi.org/10.1145/2807442.2807481>. **Best Talk Award**
14. Laput, G., Lasecki, W.S., Wiese, J., **Xiao, R.**, Bigham, J.P. and Harrison, C. (2015). Zensors: Adaptive, Rapidly Deployable, Human-Intelligent Sensor Feeds. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, USA. 1935-1944. DOI: <https://doi.org/10.1145/2702123.2702416>
13. Laput, G., **Xiao, R.**, Chen, X., Hudson, S.E., Harrison, C. (2014). Skin Buttons: Cheap, Small, Low-Powered and Clickable Fixed-Icon Laser Projectors. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology (UIST '14)*. ACM, New York, NY, USA. 389-394. DOI: <https://doi.org/10.1145/2642918.2647356>

12. **Xiao, R.**, Lew, G., Marsanico, J., Hariharan, D., Hudson, S.E., Harrison, C. (2014). Toffee: Enabling Ad Hoc, Around-Device Interaction with Acoustic Time-of-Arrival Correlation. In *Proceedings of the 16th International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '14)*. ACM, New York, NY, USA. 67-76. DOI: <http://dx.doi.org/10.1145/2628363.2628383>
11. **Xiao, R.**, Laput, G., Harrison, C. (2014). Expanding the Input Expressivity of Smartwatches with Physical Pan, Twist, Tilt and Click. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2014 (CHI '14)*. ACM, New York, NY, USA. 193-196. DOI: <https://doi.org/10.1145/2556288.2557017>
10. Schwarz, J., **Xiao, R.**, Mankoff, J., Hudson, S.E., Harrison, C. (2014). Probabilistic Palm Rejection Using Spatiotemporal Touch Features and Iterative Classification. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2014 (CHI '14)*. ACM, New York, NY, USA. 2009-2012. DOI: <https://doi.org/10.1145/2556288.2557056>
9. Harrison, C., **Xiao, R.**, Schwarz, J., Hudson, S.E. (2014). TouchTools: Leveraging Familiarity and Skill with Physical Tools to Augment Touch Interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2014 (CHI '14)*. ACM, New York, NY, USA. 2913-2916. DOI: <https://doi.org/10.1145/2556288.2557012>
8. **Xiao, R.**, Harrison, C., Hudson, S.E. (2013). Lumitrack: High Speed, High Precision, Low-Cost Tracking with Projected m-Sequences. In *Proceedings of the 26th Annual ACM Symposium on User Interface Software and Technology (UIST '13)*. ACM, New York, NY, USA. 3-12. DOI: <http://dx.doi.org/10.1145/2501988.2502022>
7. **Xiao, R.**, Harrison, C., Hudson, S.E. (2013). WorldKit: Rapid and Easy Creation of Ad-hoc Interactive Applications on Everyday Surfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2013 (CHI '13)*. ACM, New York, NY, USA. 879-888. DOI: <https://doi.org/10.1145/2470654.2466113>
6. Tang, J., **Xiao, R.**, Hoff, A., Venolia, G., Therien, P., Roseway, A. (2013). HomeProxy: Exploring a Physical Proxy for Video Communication in the Home. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2013 (CHI '13)*. ACM, New York, NY, USA. 1339-1342. DOI: <https://doi.org/10.1145/2470654.2466175>
5. Bateman, S., Mandryk, R.L., Gutwin, C., **Xiao, R.** (2013). Analysis and Comparison of Target Assistance Techniques for Relative Ray-Cast Pointing. In *International Journal of Human-Computer Studies (IJHCS)*, Volume 71, Issue 5, 511-532. DOI: <http://dx.doi.org/10.1016/j.ijhcs.2012.12.006>

4. Harrison, C., **Xiao, R.**, Hudson, S.E. (2012). Acoustic Barcodes: Passive, Durable and Inexpensive Notched Identification Tags. In *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology (UIST '12)*. ACM, New York, NY, USA, 563-568. DOI: <https://doi.org/10.1145/2380116.2380187>
3.  **Xiao, R.**, Nacenta, M., Mandryk, R.L., Cockburn, A., Gutwin, C. (2011). Ubiquitous Cursor: A Comparison of Direct and Indirect Pointing Feedback in Multi-Display Environments. In *Proceedings of Graphics Interface 2011 (GI '11)*. Canadian Human-Computer Communications Society, Waterloo, Ontario, Canada, 135-142.
Best Student Paper Award
2. Bateman, S., Doucette, A., **Xiao, R.**, Gutwin, C., Mandryk, R.L., Cockburn, A. (2011). Effects of view, input device, and track width on video game driving. In *Proceedings of Graphics Interface 2011 (GI '11)*. Canadian Human-Computer Communications Society, Waterloo, Ontario, Canada, 207-214.
1. Gutwin, C., Schneider, O., and **Xiao, R.** (2011). Chalk Sounds: Using Synthesized Audio to Improve Workspace Awareness in Distributed Groupware. In *Proceedings of the 2011 Conference on Computer Supported Cooperative Work (CSCW '11)*. ACM, New York, NY, USA, 85-94. DOI: <https://doi.org/10.1145/1958824.1958838>

PREPRINTS

3. Gholami, P. and Xiao, R. (2024). Streamlining Image Editing with Layered Diffusion Brushes. arXiv: 2405.00313 [cs.CV]. DOI: <https://doi.org/10.48550/arXiv.2405.00313>
2. Gholami, P. and **Xiao, R.** (2023). Diffusion Brush: A Latent Diffusion Model-based Editing Tool for AI-generated Images. arXiv:2306.00219 [cs.CV]. DOI: <https://doi.org/10.48550/arXiv.2306.00219>
1. Gholami, P. and **Xiao, R.** (2023). AutoDepthNet: High Frame Rate Depth Map Reconstruction using Commodity Depth and RGB Cameras. arXiv:2305.14731 [cs.CV]. DOI: <https://doi.org/10.48550/arXiv.2305.14731>

PATENTS

26. Harrison, C., **Xiao, B.R.** (2021). Inertial measurement units as vibroacoustic data receivers. Patent Application US20220011113A1, filed June 23, 2021. Patent pending.
25. Ahuja, K., Pareddy, S., **Xiao, B.R.**, Harrison, C., Goel, M. (2020). System and method using light sources as spatial anchors. Patent Application US20200357182A1, filed May 6, 2020. Patent pending.

24. Agarwal, Y., Harrison, C., Laput, G., Boovaraghavan, S., Chen C., Hota, A., **Xiao, B.R.**, Zhang, Y. (2020). Virtual sensor system. Patent Application US20200033163A1, filed January 30, 2020. Patent pending.
23. Stone, J. D., Chen, Y., Dorbala, S. P., **Xiao, B.R.** (2019). Managing activity states of an application processor in relation to touch or hover interactions with a touch sensitive device. **US Patent** 10942603, filed May 6, 2019 and granted March 9, 2021.
22. Harrison, C., **Xiao, B.R.**, Hudson, S.E. (2017). Hybrid depth and infrared image sensing and method for enhanced touch tracking on ordinary surfaces. Patent Application US20190302963A1, filed May 31, 2017. Patent pending.
21. **Xiao, B.R.**, Harrison, C., Hudson, S.E. (2017). System and Process for Enabling Secure, Instant, and Anonymous Communication Between Physically Touching Devices. **US Patent** 10942550, filed April 20, 2017 and granted March 9, 2021.
20. Agarwal, Y., Harrison, C., Laput, G., Boovaraghavan, S., Chen C., Hota, A., **Xiao, B.R.**, Zhang, Y. (2018). Virtual sensor system. **US Patent** 10436615, filed April 24, 2018 and granted October 8, 2019.
19. Schwarz, J., **Xiao, B.R.**, Benko, H., Wilson, A. (2017). Virtual object user interface display. **US Patent** 10290152, filed April 3, 2017 and granted May 14, 2019.
18. Schwarz, J., Benko, H., Wilson, A.D., Pengelly, R.C.J., **Xiao, B.R.** (2016). Interactive virtual objects in mixed reality environments. Patent Application US20180173300A1, filed December 19, 2016. Patent pending.
17. Harrison, C., **Xiao, R.**, Laput, G. (2016). Method and System for Interacting with a Wearable Electronic Device. Patent Application US20190129508, filed June 23, 2016. Patent pending.
16. Harrison, C., **Xiao, R.**, Laput, G. (2016). A System for Enabling Rich Contextual Applications for Interface-Poor Smart Devices. Patent Application US20190101992, filed April 21, 2016. Patent pending.
15. Benko, H., **Xiao, R.B.** (2016). Peripheral display for head mounted display device. **US Patent** 10175487, filed March 29, 2016 and granted January 8, 2019.
14. Yang, C., Laput, G., **Xiao, R.**, Harrison, C., Sample, A. (2015). Automatic object detection and state estimation via electronic emissions sensing. **US Patent** 9881273, filed October 28, 2015 and granted January 30, 2018.
13. Harrison, C., Schwarz, J., **Xiao, R.B.** (2015). Determining pitch for proximity sensitive interactions. **US Patent** 10564761, filed July 1, 2015 and granted February 18, 2020.

12. Laput, G., Harrison, C., Bigham, J.P., Lasecki, W.S., **Xiao, R.B.**, Wiese, J. System and method for adaptive, rapidly deployable, human-intelligent sensor feeds. **US Patent** 10657385, filed March 25, 2015 and granted May 19, 2020.
11. Harrison, C., Schwarz, J., **Xiao, R.** (2015). Method and apparatus for classifying finger touch events on a touchscreen. **US Patent** 9864454, filed February 2, 2015 and granted January 9, 2018.
10. **Xiao, R.**, Schwarz, J., Harrison, C. (2014). Method and apparatus for addressing touch discontinuities. **US Patent** 10095402, filed October 1, 2014 and granted October 9, 2018.
9. Schwarz, J., **Xiao, R.B.**, Harrison, C. (2014). Method and apparatus for classifying contacts with a touch sensitive device. US Patent Application 20160299515A1, filed September 25, 2014. Patent pending.
8. Harrison, C., **Xiao, R.B.**, Hudson, S.E., Poupyrev, I., Willis, K.D.D. (2014). System and method for tracking objects with projected m-sequences. **US Patent** 10126123, filed September 19, 2014 and granted November 13, 2018.
7. Harrison, C., Schwarz, J., **Xiao, R.B.** (2014). Method and apparatus for resolving touch screen ambiguities. **US Patent** 10096502, filed September 15, 2014 and granted October 9, 2018.
6. **Xiao, R.B.**, Lew, G., Schwarz, J., Harrison, C. (2014). Using Capacitive Images for Touch Type Classification. US Patent Application 20150242009, filed February 26, 2014. Patent pending.
5. Harrison, C., Schwarz, J., **Xiao, R.B.** (2014). Determining pitch and yaw for touchscreen interactions. **US Patent** 9778783, filed February 12, 2014 and granted October 3, 2017.
4. Harrison, C., Schwarz, J., **Xiao, R.B.** (2013). Capture of Vibro-Acoustic Data Used to Determine Touch Types. US Patent Application 20150035759, filed August 2, 2013. Patent pending.
3. Harrison, C., Schwarz, J., **Xiao, R.B.** (2013). Using Finger Touch Types to Interact with Electronic Devices. **US Patent** 10599250, filed May 6, 2013 and granted March 24, 2020.
2. Harrison, C., Schwarz, J., **Xiao, R.B.**, Hudson, S.E. (2013). Virtual Tools for Use with Touch-Sensitive Surfaces. **US Patent** 10082935, filed April 15, 2013 and granted September 25, 2018.

1. Harrison, C., Schwarz, J., **Xiao, R.B.** (2013). Method and system for activating different interactive functions using different types of finger contacts. **US Patent** 9013452, filed March 25, 2013 and granted April 21, 2015.

POSTERS

4. **Xiao, R.**, Harrison, C. (2012). Synthetic Sensors and Displays. Presented at the Qualcomm Innovation Winner's Day, September 2012.
3. **Xiao, R.**, Nacenta, M., Cockburn, A., Mandryk, R., Gutwin, C. (2010). Ubiquitous Cursor: Filling in the Space Between Displays. Presented at the University of Saskatchewan USRA Poster Fair, August 2010. **First Prize.**
2. **Xiao, R.** (2010). Ubiquitous Cursor. Presented at the University of British Columbia Rising Stars of Research poster competition. **Honorable Mention.**
1. **Xiao, R.**, Bateman, S., Mandryk, R., Gutwin, C. (2009). Enhancing the Effectiveness of Remote Pointing. Presented at the University of Saskatchewan USRA Poster Fair, August 2009. **First Prize.**

SELECTED INVITED PRESENTATIONS

11. "Exploiting a Filesystem Driver in a Kernel CTF Challenge." UBonn Guest Lecture. Bonn, Germany, August 28, 2023 (presented virtually).
10. UW Dub Seminar. Seattle, USA, November 25, 2020 (presented virtually).
9. Huawei HMI Lab. Shenzhen, China, July 14, 2020 (presented virtually).
8. CNU Information Engineering Seminar. Beijing, China, April 26, 2019.
7. DFP @ UBC Seminar Series. Vancouver, Canada, March 13, 2019.
6. "MRTouch: Adding Touch Input to Head-Mounted Mixed Reality." SIGGRAPH. Vancouver, Canada, August 12, 2018.
5. UMN CSE Colloquium. Minnesota, USA, April 9, 2018.
4. MIT CSAIL HCI Seminar Series. Boston, USA, March 19, 2018.
3. UCSB Computer Science. Santa Barbara, USA, January 18, 2018.
2. "CapCam: Enabling Quick, Ad-Hoc, Position-Tracked Interactions Between Devices." Engadget Live. New York City, USA, October 29, 2015.

1. “Evolving the Human-Computer Interface.” Co-Keynote presentation with Sir Tim Berners Lee. “WE: Way to Evolve” summit. Tencent. Shenzhen, China, November 10, 2013.

SECURITY ADVISORIES

3. Nakul Choudhary, despawningbone and Robert Xiao. CVE-2023-37271 “Arbitrary code execution via stack frame sandbox escape”, found in Zope Corporation’s RestrictedPython project (Critical Severity: NVD 9.9/10). Published July 10, 2023.
2. Corwin de Boor and Robert Xiao. CVE-2019-2684 “Vulnerability in RMI Registry bind/unbind/rebind”, found in Oracle Corporation’s Java Standard Library. Published April 16, 2019.
1. Robert Xiao. LocationSmart API Vulnerability. Published May 17, 2018.

SELECTED PRESS COVERAGE

LocationSmart, 2018

In May of 2018, I discovered a significant security vulnerability which disclosed real-time location data for a majority of mobile phone subscribers in North America.

Original coverage:

- <https://apnews.com/a60b6c98a1ff434883313469f4487639> “Website flaw exposes real-time locations of US cellphones” (May 17, 2018; syndicated to NYTimes, Washington Post, and 300 other news outlets)
- <https://www.zdnet.com/article/cell-phone-tracking-firm-exposed-millions-of-americans-real-time-locations/>
- <http://money.cnn.com/2018/05/18/technology/cell-phone-location-data-breach-locationsmart/index.html>
- Interviewed for WTAE evening broadcast TV news, May 19, 2018.
- Interviewed for “This Week in IT” radio show, June 8, 2018.

Follow-up coverage:

- <https://www.reuters.com/article/us-usa-mobile-privacy/fcc-investigating-website-flaw-that-exposed-mobile-phone-locations-idUSKCN1IJ2F0>
- <http://triblive.com/business/technology/13777194-74/verizon-to-end-some-sale-of-phone-location-data-in-wake-of-cmu> “Verizon, AT&T to end location data sales to brokers in wake of CMU hack”
- <https://www.wsj.com/articles/verizon-to-cut-off-data-providers-that-gave-up-customer-locations-1529423758> “Verizon, AT&T, Sprint to Cut Off Data Providers After Customer Locations Were Revealed”

LumiWatch, 2018

<https://www.cnet.com/news/lumiwatch-projector-smartwatch-turns-your-arm-into-a-touchscreen/>
<https://gizmodo.com/the-worlds-first-working-projector-smartwatch-turns-you-1825518454>

MRTouch, 2018

<https://www.tomshardware.com/news/mrtouch-hololens-tactive-touch-interaction,36956.html>

<https://www.digitaltrends.com/computing/microsoft-research-hololens-virtual-touchscreen-mrtouch/>

Desktopography, 2017

<http://www.dailymail.co.uk/sciencetech/article-4650346/Fancy-turning-DESK-touchscreen.html>

<http://www.popularmechanics.com/technology/gadgets/a27124/desk-touchscreen-projector/>

Deus EM Machina, 2017

<https://www.engadget.com/2017/05/09/deus-em-machina-electromagnetic-emissions-sensing/>

<https://techcrunch.com/2017/05/09/how-a-tap-could-tame-the-smart-home/>

ViBand, 2016

<https://techcrunch.com/2016/11/21/overclocked-smartwatch-sensor-uses-vibrations-to-sense-gestures-objects-and-locations/>

<https://www.theverge.com/circuitbreaker/2016/11/2/13463312/carnegie-mellon-lg-smartwatch-hack-gesture-accelerometer-viband-project>

SparseLight, 2016

<https://www.theverge.com/2016/4/26/11512820/sparselight-ar-vr-led-hack-microsoft-hololens>

<https://arstechnica.com/gaming/2016/05/how-side-mounted-leds-can-help-fix-vrs-tunnel-vision-and-nausea-problems/>

EM-Sense, 2015

<http://www.wired.com/2015/11/em-sense-enabled-smartwatch-can-detect-when-you-touch-a-doorknob/>

<http://www.nbcnews.com/tech/innovation/disney-smartwatch-knows-what-youre-touching-tells-you-what-do-n461741>

<https://www.fastcodesign.com/product/em-sense>

Zensors, 2015

<http://www.pcworld.com/article/2914552/zensors-app-lets-you-crowdsource-live.html>

<http://gizmodo.com/one-old-android-phone-could-make-all-your-dumb-things-s-1699362305>

3D Finger Angle, 2015

<http://gizmodo.com/a-touchscreen-that-knows-the-angle-of-your-finger-is-wa-1742667522>

<http://www.digitaltrends.com/mobile/qeexo-fingerangle-news/>

Skin Buttons, 2014

<http://phys.org/news/2014-10-skin-icons-smartwatch.html>

<http://www.fastcodesign.com/3036985/this-smartwatch-projects-laser-buttons-onto-your-skin>

<https://www.nytimes.com/2014/11/21/style/international/researchers-look-at-ways-to-fit-technology-in-confined-spaces.html>

Interview on CBC Radio “Misener on Tech”, October 21, 2014.

TouchTools, 2014

<http://gizmodo.com/what-life-would-be-like-if-skeuomorphism-ruled-our-ipad-1570806039>

<http://www.engadget.com/2014/05/01/touchtools-user-interface-manipulating-objects/>

6DOF Physical Smartwatch, 2014

<http://www.newscientist.com/article/dn25482-tilting-smartwatch>

<http://www.engadget.com/2014/04/30/concept-smartwatch-joystick/>

WorldKit, 2013

Work featured as segment on “Stephen Hawking’s Science of the Future”, Episode 4, December 6, 2013

<http://www.reuters.com/video/2013/06/12/researcher-gives-new-meaning?videoid=243310701>

<http://www.foxnews.com/tech/2013/07/08/projector-turns-everything-into-touchscreen/>

TEACHING EXPERIENCE

CPSC 436S “Topics in Computer Science: Computer Security” 2024

Co-creator of the course with Karina Mochetti, a fourth-year course covering various aspects of computer security, including network security, application security, cryptography, and security theory. Sole instructor for the course in Jan-Apr 2024 (2023W2).

CPSC 554X “Signal Processing and Machine Learning” 2019 – 2023

Principal creator and instructor for a graduate course on signal processing, with applications to machine learning and computer vision in the Department of Computer Science at UBC. Sessions taught: Sept-Dec 2019-2023 (2019W1, 2020W1, 2021W1, 2022W1, 2023W1).

CPSC 213 “Introduction to Computer Systems” 2019 – 2022

Principal instructor for an undergraduate course on computer systems, in the Department of Computer Science at UBC. Sessions taught: Jul-Aug 2019 (2019S2), Jan-Apr 2020-2022 (2019W2, 2020W2, 2021W2).

Lab Instructor 2014

Lab Instructor for the Programming Usable Interfaces Prototype Lab, in the Human-Computer Interaction Institute at Carnegie Mellon University, during the September-December 2014 academic term.

Teaching Assistant 2014

Teaching Assistant for an introductory course on Applied Gadgets, Sensors and Activity Recognition, taught by Scott E. Hudson, in the Human-Computer Interaction Institute at Carnegie Mellon University, during the January-April 2014 academic term.

Tutoring and TAing 2008 – 2010

Various tutoring and TA positions with the Tutorial Center and Tutoring in Residence programs (four semester-long appointments total), Faculty of Mathematics, University of Waterloo

MATH 227 TA (Calculus 3 for Honours Physics)	2009
Received outstanding evaluation from MATH 227 professor for TA work	
MATH 146 TA (Advanced Linear Algebra)	2009
Received outstanding evaluation from MATH 146 professor for TA work	
CS 116 Tutor (Intro to Computer Science 2)	2009
Developed and maintained entirely new version of the automatic grading system (used by nearly 1000 students per semester). Department of Computer Science, University of Waterloo, Waterloo, ON, Canada.	

COMMUNITY SERVICE

Program Committee Member, multiple conferences	2017 – 2023
Served as an invited program committee member for 19 conferences:	
<ul style="list-style-type: none"> • ACM Human Factors in Computing Systems - CHI (2018, 2019, 2020, 2021, 2022, 2023, 2024) • ACM User Interface Software and Technology - UIST (2019, 2020, 2021, 2023) • ACM Designing Interactive Systems - DIS (2019, 2020) • ACM Virtual Reality Software and Technology - VRST (2018) • ACM Intelligent User Interfaces - IUI (2018, 2020) • Graphics Interface - GI (2019, 2020, 2021) • Award committee member and reviewer for the Bill Buxton Dissertation Award at GI 2020 	
Demos Chair and Organizing Committee Member, MobileHCI 2022	2022
Organizer for the Demos track at MobileHCI 2022, held in Vancouver, Canada	
Contributing Writer, Crash Course Computer Science	2017
Invited contributing writer for 19 episodes of the Complexly & PBS Digital Studios “Crash Course Computer Science” educational video series.	
Student Volunteer, UIST 2017	2017
Student volunteer at the program committee meeting and main conference for the 30th Annual ACM Symposium on User Interface Software & Technology (UIST 2017).	
Session Chair, UIST 2015	2015
Chair of the “Hands and Fingers” papers session at the 28th Annual ACM Symposium on User Interface Software & Technology (UIST 2015).	

Regular Conference Paper Reviewer

Reviewer for over 100 submitted papers across several conferences, including CHI, UIST, UbiComp, DIS, CSCW, ITS/ISS and MobileHCI. Annual reviewer for CHI and UIST since 2013.

4 “*Excellent Reviewer*” distinctions received at CHI.

Journal Paper Reviewer

Reviewer for over 10 journal articles, including articles submitted to IJHCS, IEEE Computer and IEEE Photonics.

ADDITIONAL HONOURS AND AWARDS

5x First Place, DEF CON CTF

2016 – 2023

Competed with the CMU PPP team at the annual DEF CON CTF in Las Vegas. Won first place in 2016, 2017, 2019; second place in 2015, 2018, 2020, 2021.

Competed with team MMM (CMU PPP + Theori.io + UBC Maple Bacon) at the annual DEF CON CTF in Las Vegas, as well as serving as a team organizer. Won first place in 2022, 2023.

3x First Place, Codegate CTF

2016, 2020, 2023

Four-person team computer security competition, no outside/remote/offsite assistance permitted. Held annually in Seoul, South Korea (virtual in 2020).

First place in May 2016, 30,000,000 KRW (\$25,000 USD) prize.

First place in September 2020, 30,000,000 KRW (\$25,000 USD) prize.

First place in August 2023, 50,000,000 KRW (\$49,980 CAD) prize. ¼ of this prize donated to UBC to support the CTF team.

3x First Place, Google CTF

2018, 2020, 2021

Invitational final team computer security competition organized annually by Google after a qualifying round. First place with CMU PPP in Google CTF Finals 2018, 2020, and 2021.

First place, Google Capture the Flag Qualls

June 2018

Online team computer security competition; qualified to final competition held at Google.

Second place, NSA Codebreaker Challenge 2017

September 2017

Individual cryptography/reverse engineering competition held online with over 3000 participating students.

First place individual, Cambridge 2 Cambridge Challenge

July 2017

In-person computer security competition held in Cambridge, UK, among over 100 prequalified contestants. £3000 prize for first place individual.

First place team, Cambridge 2 Cambridge Challenge	July 2017
In-person computer security competition held in Cambridge, UK, among 22 teams of 5 prequalified people each. £9000 prize for first place team.	
First place, DEFCON Quals CTF	May 2017
Online team computer security competition; qualified to final competition in Las Vegas, NV.	
First place, NSA Codebreaker Challenge 2016	December 2016
Individual cryptography/reverse engineering competition held online with over 3000 participating students.	
Second place, 0CTF Finals	April 2016
Four-person team, attack-defense style computer security competition held in Shanghai, China. 20000 RMB (\$3000 USD) prize.	
Fifth place, Microsoft College Puzzle Challenge	April 2016
Four-person team, ranked fifth nationally and first at CMU.	
First place, Microsoft Build the Shield Competition	March 2016
Four-person team computer security competition held in Seattle, Washington with over 40 participating teams.	
First place, Codegate Quals CTF	March 2016
Online team computer security competition; qualified to final round in Seoul, S. Korea.	
First place, Tsinghua University BCTF	March 2016
Online team computer security and cryptography competition, over 500 participating teams.	
Fourth place, 0CTF Qualification Round	March 2016
Online team computer security competition with over 800 participating teams; qualified to final round in Shanghai, China.	
Third place, Boston Key Party CTF	March 2016
Online team computer security and cryptography competition, over 750 participating teams.	
Top 25, NSA Codebreaker Challenge 2015	December 2015
Individual cryptography/reverse engineering competition held online.	
Fifth place, HITCON 2015 Final CTF	December 2015
Four-person team computer security competition held in Taipei, Taiwan.	
First place, HITCON 2015 Quals CTF	October 2015
Online team computer security competition, qualification for final round.	

First place, Microsoft Code Hunt	August 2015
Individual programming competition held on the Microsoft campus and open to all employees.	
Third place, SECCON 2014 Final CTF	February 2015
Four-person team computer security competition held in Tokyo, Japan.	
First place, CMU-Citadel Programming Challenge	January 2015
Individual competition hosted by Citadel LLC.	
Third place, Microsoft College Puzzle Challenge	April 2014
Four-person team, ranked third in national standings.	
Invited participant of the USA Mathematics Olympiad	2007
Pythagoras Contest Canadian Champion	2001

REFERENCES

DR. CHRIS HARRISON

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5000 Forbes Ave
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