Chenhan Xu

CONTACT INFORMATION

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RESEARCH INTERESTS

My research interests fall on the intersection of **Internet of Things**, **Cybersecurity**, **Physiological Science**, and **Smart Health**. As a computer system researcher, I *model*, *design*, *build*, and *evaluate* end-to-end sensing and computing systems that aim for precise, broad-spectrum, intelligent, and secure human-computer interaction (HCI) and personalized healthcare within IoT context. My research ranges from *theory* to *implementation*, and has primarily focused on three aspects:

Secure Precision Sensing in IoT: exploring new sensing technologies (mainly *wireless*) to precisely, securely, and robustly interrogate human physiological information, including noise-immune voice tone [MobiSys'19] and resilient voice biometrics [SenSys'20], fine-grained heart activities [UbiComp'21], anti-spoofing fingerprint [NDSS'22], and authentic body inertia [ICHI'22].

Novel Human-IoT Interface: investigating new interfaces between human and IoT through broad-spectrum wireless modalities of human physiological activities (e.g., IoT-heart interface via voice [SenSys'22] and mmWave [UbiComp'21]).

Pervasive and Privary-preserving Healthcare: exploring effortless, accurate, and secure health monitoring and disease prevention through IoT devices and facilities, including passive medication adherence management of Parkinson's disease (PD) [UbiComp'19] and privacy-preserving early detection of PD [MobiCom'19].

EDUCATION

University at Buffalo, the State University of New York (SUNY) *Aug. 2018 - Jun. 2023*
Ph.D., Computer Science — Supervised by Prof. Wenyao Xu
Thesis: Towards Wireless Precision Sensing in IoT for Human Interaction, Healthcare, and Beyond

Nanjing University of Posts and Telecommunications (NUPT) *Sept. 2013 - Jun. 2017*
B.Eng., Network Engineering

RESEARCH EXPERIENCE

Snap Research (Computational Imaging Team) *May. 2022 - Sept. 2022*
Research Intern — Mentor: Dr. Bing Zhou

- Develop energy-efficient and high-precision finger-tracking *hardware with multi-sensor fusion and on-chip signal processing*.
- Design and implement *multi-modality deep learning*-based finger tracking pipeline.
- Conduct *experiments on human subjects* to evaluate finger tracking performance.

NUPT Center for Learning, Energy and Networks (NCLEN) *Jul. 2017 - May 2018*
Research Intern — Advisor: Prof. Kun Wang

- Design and implement battery-friendly and *secure consensus algorithm for blockchain* system on IoT devices.
- Design and implement lightweight transaction to reduce storage requirement of blockchain on IoT devices.

NUPT Center for Learning, Energy and Networks (NCLEN) *Jul. 2015 - May 2017*
Undergraduate Research Assistant — Advisor: Prof. Kun Wang

- Explore and design blockchain and smart contrast-based decentralized resource management framework for data center.

- Implement machine learning-based electricity price analysis and forecasting for smart grid.

Honors and Awards

- **Best Student Paper Award**, IEEE International Conference on Healthcare Informatics (ICHI), 2022 (2 out of 109)
- **Honorable Mention**, Russell Agrusa CSE Student Innovation Competition, University at Buffalo (5 out of 17)
- **Honorable Mention**, Design Automation Conference (DAC) University Demo Best Demonstration, 2021
- **Best Paper Award**, the 18th ACM International Conference on Mobile Systems, Applications, and Services (MobiSys), 2020 (1 out of 175)
- **First Year Achiever Award**, Department of Computer Science and Engineering, University at Buffalo, 2019
- **Best Paper Award**, the 17th ACM Conference on Embedded Networked Sensor Systems (SenSys), 2019 (1 out of 144)
- **Student Travel Grant**, the 17th ACM International Conference on Mobile Systems, Applications, and Services (MobiSys), 2019
- **Best Paper Award** IEEE Communications Society Technical Committee on Big Data International Conference on Communications (ICC), 2019
- **Chair's Fellowship**, Department of Computer Science and Engineering, University at Buffalo, 2018
- **Best Paper Award**, IEEE Global Communications Conference (GlobeCom), 2016 (2 out of 135)

Selected Publications

[**CHI'23**] **Chenhan Xu**, Bing Zhou, Gurunandan Krishnan, Shree Nayar, "*AO-Finger: Hands-free Fine-grained Finger Gesture Recognition via Acoustic-Optic Sensor Fusing*", Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems, Hamburg, Germany, Apr. 2023.

[**SenSys'22**] **Chenhan Xu**, Tianyu Chen, Huining Li, Alexander Gherardi, Michelle Weng, Zhengxiong Li, Wenyao Xu, "*Hearing Heartbeat from Voice: Towards Next Generation Voice-User Interfaces with Cardiac Sensing Function*", ACM Conference on Embedded Networked Sensor Systems, Boston, MA, Nov. 2022. (Best Paper Award Candidate, 7 out of 209; Acceptance Rate: 24.8%, 52 out of 209)

[**ICHI'22**] **Chenhan Xu**, Huining Li, Zhengxiong Li, Xingyu Chen, Aditya Singh Rathore, Hanbin Zhang, Kun Wang, Wenyao Xu, "*The Visual Accelerometer: A High-fidelity Optic-to-Inertial Transformation Framework for Wearable Health Computing*", IEEE International Conference on Health Informatics, Rochester, MN, June 2022. (Best Student Paper Award, 2 out of 109, 1.8%)

[**UbiComp'21**] **Chenhan Xu**, Huining Li, Zhengxiong Li, Hanbin Zhang, Aditya Singh Rathore, Xingyu Chen, Kun Wang, Ming-Chun Huang, Wenyao Xu, "*CardiacWave: A mmWave-based Scheme of Non-Contact and High-Definition Heart Activity Computing*", ACM International Joint Conference on Pervasive and Ubiquitous Computing, Virtual Conference. (Round-1 Initial Acceptance in May: 2.14%, 3 out of 140, overall AR: 25%)

[**SenSys'20**] Huining Li, **Chenhan Xu**, Aditya Singh Rathore, Zhengxiong Li, Hanbin Zhang, Chen Song, Kun Wang, Lu Su, Feng Lin, Kui Ren, Wenyao Xu, "*VocalPrint: Exploring A Resilient and Secure Voice Authentication via mmWave Biometric Interrogation*", ACM Conference on Embedded Networked Sensor Systems, Yokohama, Japan. (Acceptance Rate: 20.6%, 44 out of 213)

[**MobiSys'19**] **Chenhan Xu**, Zhengxiong Li, Hanbin Zhang, Aditya Singh Rathore, Huining Li, Chen Song, Kun Wang, Wenyao Xu, "*WaveEar: Exploring a mmWave-based Noise-resistant Speech Sensing for Voice-User Interface*", The 17th ACM International Conference on Mobile Systems, Applications, and Services, Seoul, South Korea. (Acceptance Rate: 23.2%, 40 out of 172)

[**TPDS'19**] **Chenhan Xu**, Kun Wang, Peng Li, Song Guo, Jiangtao Luo, Baoliu Ye, Minyi Guo, "*Making big data open in edges: A resource-efficient blockchain-based approach*", IEEE Transactions on Parallel and Distributed Systems, Volume 30, Number 4, April 2019, Pages 870 - 882.

Teaching Experiences

CSE111: Introduction to Quantitative Analysis and Reasoning with Computing [Spring 2019, Spring 2020]
CSE305: Introduction to Programming Language [Fall 2018]
CSE321: Embedded and Real-time Operating System [Fall 2019]
CSE341: Computer Organization [Fall 2020, Spring 2021]
CSE460: Data Models and Query Languages (Guest Lecturer) [Summer 2019]

Mentoring Experiences

I mentored 6 students from UB and K-12 schools, including two *female students*.

Tianyu Chen (Undergrad, CSE@UB, co-authored [SenSys'22], Current: M. S. student CSE@UB)
Alexander Gherardi (Undergrad, CSE@UB, co-authored [Sensys'22])
Michelle Weng (Undergrad, CSE@UB, co-authored [Sensys'22])
Jieyi Li (Undergrad, CSE@UB, Current: Software Engineer, Bank of America)
Xingyu Chen (Undergrad, CSE@UB, co-authored [UbiComp'21, SenSys'20], Current: Ph.D. student, CSE@UCSD, co-mentored with Dr. Zhengxiong Li)
Gabriel Guo (K-12 Student, co-authored [UbiComp'22, MobiCom'20], Current: Undergrad, Columbia University, co-mentored with Dr. Hanbin Zhang)

Grants Experiences

I assisted in the preparation of proposals for the following research grants:

[**Grant Writing**] NSF OAC: Small: Open-Source Efficient Tools for Real-time Human Dynamic Capture using Wireless Signals (to be submitted on Dec 2022)

[**Grant Assistant**] NSF EAGER: SARE: Collaborative Research: Exploring and Mitigating Attacks of Millimeter-wave Radar Sensors in Autonomous Vehicles, $170,000, 2020/09/01 - 2022/08/31

Publications

I have published more than 30 research/demo papers in high-impact venues for mobile computing (e.g., MobiCom, MobiSys, SenSys), human-computer interaction (UbiComp, CHI), smart health/bioinformatics (e.g., ICHI, CHASE), and security (NDSS). These papers have obtained more than 1000 citations. My google Scholar: `https://scholar.google.com/citations?user=KnwMxZ8AAAAJ&hl=en&oi=ao`

[**CHI'23**] **Chenhan Xu**, Bing Zhou, Gurunandan Krishnan, Shree Nayar, "*AO-Finger: Hands-free Fine-grained Finger Gesture Recognition via Acoustic-Optic Sensor Fusing*", Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems, Hamburg, Germany, Apr. 2023.

[**SenSys'22**] **Chenhan Xu**, Tianyu Chen, Huining Li, Alexander Gherardi, Michelle Weng, Zhengxiong Li, Wenyao Xu, "*Hearing Heartbeat from Voice: Towards Next Generation Voice-User Interfaces with Cardiac Sensing Function*", ACM Conference on Embedded Networked Sensor Systems, Boston, MA, Nov. 2022.

[**ICHI'22**] **Chenhan Xu**, Huining Li, Zhengxiong Li, Xingyu Chen, Aditya Singh Rathore, Hanbin Zhang, Kun Wang, Wenyao Xu, "*The Visual Accelerometer: A High-fidelity Optic-to-Inertial Transfor-*

mation Framework for Wearable Health Computing", IEEE International Conference on Health Informatics, Rochester, MN, June 2022.

[**UbiComp'22**] Zhengxiong Li, Baicheng Chen, Xingyu Chen, **Chenhan Xu**, Yuyang Chen, Feng Lin, Changzhi Li, Karthik Dantu, Kui Ren, Wenyao Xu, "*Trustworthy Digital Forensics in the Air: Exploring An RF-based Drone Identification System*", ACM International Joint Conference on Pervasive and Ubiquitous Computing, September 2022.

[**UbiComp'22**] Gabriel Guo, Hanbin Zhang, Liuyi Yao, Zhengxiong Li, Huining Li, **Chenhan Xu**, Wenyao Xu, "*MSLife Digital Behavioral Phenotyping of Multiple Sclerosis Symptoms in the Wild using Wearables and Graph-Based Statistical Analysis*", ACM International Joint Conference on Pervasive and Ubiquitous Computing, September 2022.

[**NDSS'22**] Aditya Rathore, Yijie Shen, **Chenhan Xu**, Jacob Snyderman, Jinsong Han, Fan Zhang, Zhengxiong Li, Feng Lin, Wenyao Xu, Kui Ren, "*FakeGuard: Exploring haptic response to mitigate the vulnerability in commercial fingerprint anti-spoofing*", The Network and Distributed System Security Symposium, San Diego, CA, February 2022.

[**NDSS'22**] Zhengxiong Li, Baicheng Chen, Xingyu Chen, Huining Li, **Chenhan Xu**, Chris Xiaoxuan Lu, Feng Lin, Kui Ren, Wenyao Xu, "*SpiralSpy: Exploring a Stealthy and Practical Covert Channel to Attack Air-gapped Computing Devices via mmWave Sensing*", The Network and Distributed System Security Symposium, San Diego, California, February 2022.

[**TMC'22**] Huining Li, **Chenhan Xu**, Aditya Singh Rathore, Zhengxiong Li, Hanbin Zhang, Chen Song, Kun Wang, Lu Su, Feng Lin, Kui Ren, Wenyao Xu, "*VocalPrint: A mmWave-based Unmediated Vocal Sensing System for Secure Authentication*", to appear IEEE Transactions on Mobile Computing.

[**TMC'22**] Aditya Singh Rathore, **Chenhan Xu**, Weijin Zhu, Afee Daiyan, Kun Wang, Feng Lin, Kui Ren, Wenyao Xu, "*Scanning the Voice of Your Fingerprint with Everyday Surfaces*", IEEE Transactions on Mobile Computing, vol. 21, no. 8, August 2022, Pages 3024-3040.

[**SH'22**] Huining Li, Enhao Zheng, Zijian Zhong, **Chenhan Xu**, Nicole Roma, Steven Lamkin, Tania T Von Visger, Yu-Ping Chang, Wenyao Xu, "*Stress prediction using micro-EMA and machine learning during COVID-19 social isolation*", Elsevier Smart Health, Volume 23, March 2022.

[**SH'22**] Huining Li, Huan Chen, **Chenhan Xu**, Anarghya Das, Xingyu Chen, Zhengxiong Li, Jian Xiao, Ming-Chun Huang, Wenyao Xu, "*Privacy computing using deep compression learning techniques for neural decoding*", Elsevier Smart Health, Volume 23, March 2022.

[**UbiComp'21**] **Chenhan Xu**, Huining Li, Zhengxiong Li, Hanbin Zhang, Aditya Singh Rathore, Xingyu Chen, Kun Wang, Ming-Chun Huang, Wenyao Xu, "*CardiacWave: A mmWave-based Scheme of Non-Contact and High-Definition Heart Activity Computing*", ACM International Joint Conference on Pervasive and Ubiquitous Computing, Virtual, September 2021.

[**GetMobile'21**] Aditya Singh Rathore, **Chenhan Xu**, Wenyao Xu, "*SonicPrint: Discovering the Voice of Fingerprint for Adoptable Biometrics*", ACM GetMobile: Mobile Computing and Communication, Volume 24, Number 4, March 2021, Pages 43-46.

[**SenSys'20**] Huining Li, **Chenhan Xu**, Aditya Singh Rathore, Zhengxiong Li, Hanbin Zhang, Chen Song, Kun Wang, Lu Su, Feng Lin, Kui Ren, Wenyao Xu, "*VocalPrint: Exploring A Resilient and Secure Voice Authentication via mmWave Biometric Interrogation*", ACM Conference on Embedded Networked Sensor Systems, Yokohama, Japan, November 2020.

[**SenSys'20**] Xingyu Chen, **Chenhan Xu**, Baicheng Chen, Zhengxiong Li, Wenyao Xu, "*Poster: In-ear thermometer: wearable real-time core body temperature monitoring*", ACM Conference on Embedded Networked Sensor Systems, Yokohama, Japan, Nov. 2020.

[**MobiCom'20**] Hanbin Zhang, Gabriel Guo, Chen Song, **Chenhan Xu**, Kevin Cheung, Jasleen Alexis, Huining Li, Dongmei Li, Kun Wang, Wenyao Xu, "*PDLens: Smartphone Knows Drug Effectiveness among Parkinson's via Daily-Life Activity Fusion*", ACM International Conference on Mobile Computing and Networking, London, UK, October 2020.

[**MobiCom'20**] Baicheng Chen, Huining Li, Zhengxiong Li, **Chenhan Xu**, Xingyu Chen, Wenyao Xu, "*ThermoWave: A New Paradigm of Wireless Passive Temperature Monitoring via mmWave Sensing*", ACM International Conference on Mobile Computing and Networking, London, UK, October 2020.

[**MobiSys'20**] Aditya Singh Rathore, Weijin Zhu, Afee Daiyan, **Chenhan Xu**, Kun Wang, Feng Lin, Kui Ren, Wenyao Xu, "*SonicPrint: A Generally Adoptable and Secure Fingerprint Biometrics in Smart Devices*", ACM International Conference on Mobile Systems, Applications, and Services, Toronto, Canada, June 2020.

[**CCFToN'20**] Baicheng Chen, Kunwoo Cho, **Chenhan Xu**, Zhengxiong Li, Feng Lin, Zhanpeng Jin, Wenyao Xu, "*A Stimulus-Response Based EEG Biometrics using Mallow's Distance*", CCF Transactions on Networking, Volume 3, Number 2, July 2020, Pages 128 - 139.

[**TNSE'20**] **Chenhan Xu**, Kun Wang, Peng Li, Rui Xia, Song Guo, Minyi Guo, "*Renewable Energy-Aware Big Data Analytics in Geo-distributed Data Centers with Reinforcement Learning*", IEEE Transactions on Network Science and Engineering, Volume 7, Number 1, January 2020, Pages 205 - 215.

[**DSC'20**] Baicheng Chen, Kun Woo Cho, **Chenhan Xu**, Feng Lin, Zhanpeng Jin, Wenyao Xu, "*Exploiting Mallows Distance to Quantify EEG Distribution for Personal Identification*", IEEE Conference on Dependable and Secure Computing, Hangzhou, China, November 2019.

[**MobiSys'19**] **Chenhan Xu**, Zhengxiong Li, Hanbin Zhang, Aditya Singh Rathore, Huining Li, Chen Song, Kun Wang, Wenyao Xu, "*WaveEar: Exploring a mmWave-based Noise-resistant Speech Sensing for Voice-User Interface*", ACM International Conference on Mobile Systems, Applications, and Services, Seoul, South Korea, June 2019.

[**UbiComp'19**] Hanbin Zhang, **Chenhan Xu**, Huining Li, Aditya Singh Rathore, Chen Song, Zhisheng Yan, Dongmei Li, Feng Lin, Kun Wang, Wenyao Xu, "*PDMove: Towards Passive Medication Adherence Monitoring of Parkinson's Disease Using Smartphone-based Gait Assessment*", ACM International Joint Conference on Pervasive and Ubiquitous Computing, London, UK, September 2019

[**SenSys'19**] Zhengxiong Li, Baicheng Chen, Zhuolin Yang, Huining Li, **Chenhan Xu**, Xingyu Chen, Kun Wang, and Wenyao Xu, "*FerroTag: A Paper-based mmWave-Scannable Tagging Infrastructure*", ACM Conference on Embedded Networked Sensor Systems, New York City, NY, November 2019.

[**MobiCom'19**] Hanbin Zhang, Chen Song, Aosen Wang, **Chenhan Xu**, Dongmei Li, Wenyao Xu, "*PDVocal: Towards Privacy-preserving Parkinson's Disease Early Detection using Passive Body Sounds in Daily Life*", ACM International Conference on Mobile Computing and Networking, Los Cabos, Mexico, October 2019.

[**NMAG'19**] Huining Li, Kun Wang, Toshiaki Miyazaki, **Chenhan Xu**, Song Guo, Yanfei Sun, "*Trust-Enhanced Content Delivery in Blockchain-Based Information-Centric Networking*", IEEE Network, Volume 33, Number 5, September 2019, Pages 183 - 189.

[**TPDS'19**] **Chenhan Xu**, Kun Wang, Peng Li, Song Guo, Jiangtao Luo, Baoliu Ye, Minyi Guo, "*Making big data open in edges: A resource-efficient blockchain-based approach*", IEEE Transactions on Parallel and Distributed Systems, Volume 30, Number 4, April 2019, Pages 870 - 882.

[**TBD'19**] Kun Wang, **Chenhan Xu**, Yan Zhang, Song Guo, Albert Zomaya, "*Robust big data analytics for electricity price forecasting in the smart grid*", IEEE Transactions on Big Data, Volume 5, Number 1, March 2019, Pages 34 - 45.

[**TNSE'19**] **Chenhan Xu**, Kun Wang, Yanfei Sun, Song Guo, Albert Zomaya, "*Redundancy Avoidance for Big Data in Data Centers: A Conventional Neural Network Approach*", IEEE Transactions on Network Science and Engineering, Volume 7, Number 1, January 2019, Pages 104 - 114.

[**ICC'18**] **Chenhan Xu**, Kun Wang, Guoliang Xu, Peng Li, Song Guo, Jiangtao Luo, "*Making big data open in collaborative edges: a blockchain-based framework with reduced resource requirements*", IEEE International Conference on Communications, Kansas City, MO, USA, May 2018.

[**CC'17**] **Chenhan Xu**, Kun Wang, Mingyi Guo, "*Intelligent resource management in blockchain-based cloud datacenters*", IEEE Cloud Computing, Volume 4, Number 6, November 2017, Pages 50 - 59.

[**TOMM'16**] Kun Wang, Jun Mi, **Chenhan Xu**, Qingquan Zhu, Lei Shu, Der-Jiunn Deng, "*Real-time load reduction in multimedia big data for mobile Internet*", ACM Transactions on Multimedia Computing, Communications, and Applications, Volume 12, Number 5, November 2016, Pages 1 - 20.

[**GlobeCom'16**] Kun Wang, **Chenhan Xu**, Song Guo, "*Big data analytics for price forecasting in smart grids*", IEEE Global Communications Conference, Washington, DC, USA, December 2016.

[**ICCC'16**] Kun Wang, Jun Mi, **Chenhan Xu**, Lei Shu, Der-Jiunn Deng, "*Real-time big data analytics for multimedia transmission and storage*", IEEE/CIC International Conference on Communications in China, Chengdu, China, July, 2016.

[**ICC'16**] Li Yang, Kun Wang, **Chenhan Xu**, Chunsheng Zhu, Yanfei Sun, "*An incremental learning classification algorithm based on forgetting factor for eHealth networks*", IEEE International Conference on Communications, Kuala Lumpur, Malaysia, May 2016.

Community Services

TPC Membership:

- IEEE International Performance Computing and Communications Conference (IPCCC) [2023]
- International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP) [2023]
- ACM Conference on Embedded Networked Sensor Systems (SenSys) Shadow PC [2022]
- IEEE International Conference on Communications (ICC) [2018, 2019, 2020]

Reviewer:

- ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp) [2022, 2023]
- ACM Transactions on Sensor Networks (TOSN)
- ACM Transactions on Mobile Computing (TMC)
- IEEE Internet of Things Journal (IOTJ)
- IEEE International Conference on Computer Communications (INFOCOM) [2021, 2022]
- IEEE/ACM international conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE) [2019, 2020]
- IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI) [2019]
- IEEE Transactions on Services Computing
- IEEE Transactions on Parallel and Distributed Systems (TPDS)
- IEEE Communications Magazine
- IEEE Network Magazine
- IEEE Transactions on Vehicular Technology (TVT)
- IEEE Transactions on Emerging Topics in Computing
- International Conference on Wireless Communications and Signal Processing [2016]

Presentations

Invited Talk, NSF REU Site@UB — Jul. 2022
Research Paper Writing

Conference Talk, ICHI' 22 — Jun. 2022
The Visual Accelerometer: A High-fidelity Optic-to-Inertial Transformation Framework for Wearable Health Computing

Conference Talk, UbiComp' 21 Sept. 2021
CardiacWave: A mmWave-based Scheme of Non-Contact and High-Definition Heart Activity Computing

Invited Talk, UpBeat@UB-CSE Sept. 2019
WaveEar: Exploring a MmWave-Based Noise-Resistant Speech Sensing for Voice-User Interface

Conference Talk, MobiSys' 19 Jun. 2019
WaveEar: Exploring a MmWave-Based Noise-Resistant Speech Sensing for Voice-User Interface