

# Chenhan Xu

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## 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 [ICH'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 Privacy-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 - Present*  
Ph.D., Computer Science      Supervised by Prof. Wen Yao 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 (NCLN)**      *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 (NCLN)**      *Jul. 2015 - May 2017*  
Undergraduate Research Assistant      Advisor: Prof. Kun Wang

- Explore and design blockchain and smart contract-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

- [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. ([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), smart health/bioinformatics (e.g., ICHI, CHASE), and security (NDSS). These papers have obtained more than **900** citations. My google Scholar: <https://scholar.google.com/citations?user=KnwMxZ8AAAAJ&hl=en&oi=ao>

[**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 Transformation 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 Wear-*

*ables 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, Weijin Zhu, Afee Daiyan, **Chenhan Xu**, 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:**

- ACM 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]
- ACM Transactions on Mobile Computing (TMC) [2022]
- IEEE Internet of Things Journal (IOTJ) [2022]
- 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 [2019]
- IEEE Transactions on Parallel and Distributed Systems (TPDS) [2018]
- IEEE Communications Magazine [2018, 2019]
- IEEE Network Magazine [2018]
- IEEE Transactions on Vehicular Technology (TVT) [2019]
- IEEE Transactions on Emerging Topics in Computing [2018]
- International Conference on Wireless Communications and Signal Processing [2016]

PRESENTATIONS

**Invited Talk**, NSF REU Site@UB  
*Research Paper Writing*

Jul. 2022

**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*