Christopher R. Wren, Ph.D.

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Experience

United States Digital Service, Executive Office of the President of the United States
GS15 Software Engineer and Data Scientist, Remote, active Top Secret / SCI
2021 – 2025
Rapid response software engineering, process engineering, forensic engineering, forensic data science, policy implementation, and engineering management for government projects on small, cross-functional teams.

Supporting State Medicaid Departments during the Public Health Emergency Unwinding
Diagnosed logic flaws and data-sharing disconnects in state Medicaid eligibility systems and processes, saving *millions* of hours of staff and beneficiary time, and preventing wrongful disenrollments. Resolved misunderstandings between policy and operations. *Spot award, USDS exemplary service challenge coin.*

Facing a Financial Shock
Researched cross-benefit income verification options for Medicaid and SNAP. Surveyed existing private-sector solutions. Developed system designs that informed the ongoing Income Verification as a Service project.

Refugee Coordination Center
Improved interagency coordination with user research and data analysis. Diagnosed processing backlogs. Delivered new scheduling tools to reduce delays, based on international field research. *Spot award.*

Operation Allies Refuge
Delivered a 30X reduction in refugee admissions processing time, enabling the evacuation of U.S. allies from Afghanistan, based on data analysis, policy research, and staff interviews. Implemented on site while building coordination channels between federal, Army, UN, and NGO staff. *Spot award.*

Operation Allies Welcome
Streamlined and automated the travel scheduling for 80,000 Afghan evacuees. Solved a complex constrained optimization problem with competing inputs from policy, logistic, medical, family, military, and volunteer stakeholders. Delivered simulations and visualizations to focus the team on human outcomes. Claimed to be the first successful sharing of information across Dept. Homeland Security components. *Department of Defense challenge coin.*

Alphabet, Inc., Google
Senior Staff Software Engineer, Cambridge, MA, USA
2008 – 2021
Software and user experience analytics at global-scale: API design, user interface innovation on both mobile and the web, in social and mobile platform product contexts. Built, resourced, and maintained distributed teams. Internal and external public speaking. Launched many major product improvements and platforms to billions of users. Numerous internal awards.

Quantitative User Experience pipelines for Android
Created, resourced, built, and managed a team to design and deliver a novel user experience metrics platform for the Android mobile operating system, leveraging privacy preserving technologies. Created a data governance model for feature teams and served as liaison to the Privacy Working Group. Leadership wrote: "Chris filled an enormous, dangerous void by addressing a very literal blind spot for Android. [His work] represents a landmark achievement in Android's history and a turning point in how we operate."

Android Notifications Technical Lead for Android
Recognized a need and advocated for the creation of this role. Used soft power to gather resources and lead the transformation of notifications into a headline feature: `Wired magazine`: "Our favorite thing? Notifications. They're simply the best. They have become the centerpiece of the device experience."

Massachusetts Institute of Technology, Media Laboratory, Human Dynamics Group
Visiting Scientist, Cambridge, MA, USA
2017 – 2019
Mentorship and technology transfer. Topics included data privacy and digital contracts for data governance.

Mitsubishi Electric Research Laboratories
Principal Research Scientist, Cambridge, MA, USA
Research Laboratory
2001 – 2008
Invention and prototyping of perceptual and context-aware systems for human interface and automation in the context of smart buildings, personal computing, and health care. Internal technology transfer, internal and external technical demonstrations and public speaking. Extensive patent disclosure and academic publication.

Perceptive Network Technologies, Inc.
Senior Perceptual Engineer, Waltham, MA, USA
2000 – 2001
Founding member of a start-up bringing perceptual technology to chat and video conferencing applications to create context-aware communication products. Full-stack Windows development including device interface, signal processing, and user interface design and implementation. Set company technical culture and development processes.

Massachusetts Institute of Technology, Media Laboratory, Vision and Modeling Group
Research Assistant, Cambridge, MA, USA
1994 – 2000
Invented and developed perceptual toolkits used internationally by many academic and research institutions. Statistical computer vision combined with techniques from artificial intelligence and control theory, embedded in systems with human-centered design principles. Large-scale demonstrations, often in collaboration with digital artists. Extensive public speaking, including presentations to corporate sponsors.

Boston Dynamics Inc.
Engineer and Dynamicist, Cambridge, MA, USA
1993 – 1994
Fifth employee. Built physics-based simulations, animation systems, and haptic interfaces for academic, industrial, and governmental clients, in a fast-paced, start-up consulting environment.

Education

Doctor of Philosophy, Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
Thesis Title: "Understanding Expressive Action."
Minor: "Stochastics, Dynamics, and Recursive Filtering."

Master of Science, Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
Thesis Title: "Pfinder: Real-Time Tracking of the Human Body"

Bachelor of Science, Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
Minor: Cognitive Psychology.

Secondary Education Western Reserve Academy, Hudson, OH, USA

Government Reports and Analysis

"Medicaid Process Improvements" U. S. Digital Service Medicaid Renewals Team. chapter in "Tackling the Time Tax 2024 Edition" Executive Office of the President, Office of Information and Regulatory Affairs. July 2024.

"Budget of the United States Government: Fiscal Year 2025" Joseph R. Biden, *et al. Executive Office of the President, Office of Management and Budget. March 2024*

"U.S. Digital Service - Medicaid Renewals Playbook" U. S. Digital Service Medicaid Renewals Team. Executive Office of the President, United States Digital Service. October 2023.

"*Budget of the United States Government: Fiscal Year 2024*" *Joseph R. Biden,* et al. Executive Office of the President, Office of Management and Budget. March 2023

"Budget of the United States Government: Fiscal Year 2023" Joseph R. Biden, *et al. Executive Office of the President, Office of Management and Budget. March 2022*

Lectures, Workshops, and Tutorials

"Translating Policy into Action: A Cross-Disciplinary Approach to Reducing Burden in the Medicaid Renewals Process" Megan Cage, Christopher Wren, Yingjia Huang, Sara Oberst. Medicaid Enterprise Systems Conference, 2024. Louisville, KY, USA. August 2024.

"It's Not Just You: Our Mutual Implementation Challenges and What to do About Them" Christopher Wren, Megan Cage, Aryeh Jacobsohn Zachary Withers, Patrick Sier. Medicaid Enterprise Systems Conference, 2024. Louisville, KY, USA. August 2024.

"Benefits Data Workshop" Alicia Rouault, Luke Farrell, Maxwell Mazzocchi, Rachael Dietkus, Christopher Wren. Aspen Institute Financial Resilience Summit. Washington, DC, USA. February 2023.

"Respecting User Attention: Notification Best Practices" at the Android Developer Summit, Mountain View, California, November 2015.
https://youtu.be/WzRSpZpw2wg

"Android and You" TEDxBeaconStreet, Brookline, Massachusetts, November 2014.
https://youtu.be/Wn7qWrMWlH8

"Sensor Networks for Better Buildings" Google TechTalks, Mountain View, California, February 2007.
https://youtu.be/OZd5IaN63CY

"Using sensor networks for action recognition" Neural Information Processing Systems 2005 Workshop on Recognition and Discovery of Activities and Interactions. Whistler, British Columbia, Canada, December 2005.

"Activity Mining in Sensor Networks." Neural Information Processing Systems 2004 Workshop on Activity Recognition and Discovery. Whistler, British Columbia, Canada, December 2004.

Hobbies

hiking, camping, cycling, board games, video games, geo-location games, 3D computer-aided design, 3D printing, embedded electronics, flying (active private pilot license), hanging out with my family

Refereed Journal Papers and Chapters

"Visualizing the History of Living Spaces" Yuri A. Ivanov, Christopher R. Wren, Alexander Sorokin, Ishwinder Kaur. IEEE Transactions on Visualization and Computer Graphics 13(6) pp 1153–1160. November 2007. **Best Paper Prize**.

"Functional Calibration for Pan-Tilt-Zoom Cameras in Hybrid Sensor Networks." Christopher R. Wren, Murat Erdem, Ali J. Azarbayejani. ACM Multimedia Systems Journal, Special Issue on Multimedia Surveillance Systems. Online October 9, 2006. (updated version of MERL TR2005-084)

"Similarity-based analysis for large networks of ultra-low resolution sensors." Christopher R. Wren, David Minnen, and Srinivas G. Rao Pattern Recognition, volume 39, issue 10, pp. 1918–1931. Special Issue on Similarity-Based Pattern Recognition. Elsevier. October 2006.

"Perception for Human Motion Understanding," Christopher R. Wren in "Innovations in Machine Intelligence & Robot Perception" Vol. 7. Patnaik, Jain, Tzafestas, and Banoore (Eds.) Springer. 2005, IX. pp. 265–324.

"Minimalism in Ubiquitous Interface Design", Christopher R. Wren and Carson J. Reynolds. Personal and Ubiquitous Computing, September 2004, 8(5), pp. 370-373.

"Perceptive Spaces for Performance and Entertainment: Untethered Interaction using Computer Vision and Audition." Christopher R. Wren, Flavia Sparacino, Ali J. Azarbayejani, Trevor J. Darrell, Thad E. Starner, Akira Kotani, Chloe M. Chao, Michal Hlavac, Kenneth B. Russell, Alex P. Pentland. Applied Artificial Intelligence, June 1997, 11(4), pp. 267-284.

"Pfinder: Real-Time Tracking of the Human Body." Christopher R. Wren, Ali J. Azarbayejani, Trevor Darrell, and Alex P. Pentland. IEEE Trans. on Pattern Analysis and Machine Intelligence, 1997, 19(7), pp. 780-785. **6,000+ citations**

Refereed Conference and Workshop Papers

"Google+ Ripples: A Native Visualization of Information Flow." Fernanda Viegas, Martin Wattenberg, Jack Hebert, Geoffrey Borggaard, Alison Cichowlas, Jonathan Feinberg, Jon Orwant, and Chris Wren, Proceedings of the 22nd International World Wide Web Conference, May 2013. Rio de Janeiro, Brazil.
see also https://youtu.be/_j0I1a_Aw4g

"Pokey: Interaction through covert structured light." Christopher R. Wren, Yuri Ivanov, Paul Beardsley, Biliana Kaneva, and Shoji Tanaka, Third IEEE International Workshop on Horizontal Interactive Human Computer Systems (TABLETOP). October 2008. Amsterdam.

"Ambient Intelligence as the Bridge to the Future of Pervasive Computing" Christopher R. Wren, Yuri A. Ivanov. Eighth International Conference on Automatic Face and Gesture Recognition. September 2008. Amsterdam.

"Soda Pop Zombies: Soft Drink Consumption and Motion" Daniel Wigdor, Yuri A. Ivanov, Christopher R. Wren. Proceedings of the 2007 ICMI Workshop on Massive Datasets. Nov. 2007. Nagoya, Japan.

"SocialMotion: Measuring the Hidden Social Life of a Building" Christopher R. Wren, Yuri A. Ivanov, Ishwinder Kaur, Darren Leigh, Jonathan Westhues. Third International Symposium on Location- and Context-Awareness. September 2007. Oberpfaffenhofen, Germany.

"Tracking People in Mixed Modality Systems" Yuri Ivanov, Alexander Sorokin, Christopher Wren, Ishwinder Kaur. Visual Communications and Image Processing 2007. February 2007. San Jose, California.

"Toward Scalable Activity Recognition for Sensor Networks" Christopher R. Wren and Emmanuel Munguia Tapia. Second International Workshop on Location- and Context-Awareness. 10-11 May 2006. Dublin, Ireland.

"Worse is Better for Ambient Sensing" Carson J. Reynolds and Christopher R. Wren. Pervasive 2006 Workshop on Privacy, Trust and Identity Issues for Ambient Intelligence. May 7th, 2006. Dublin, Ireland.

"Toward Spatial Queries for Spatial Surveillance Tasks" Christopher R. Wren and Yuri A. Ivanov. Pervasive 2006 Workshop on on Pervasive Technology Applied Real-World Experiences with RFID and Sensor Networks. May 7, 2006. Dublin, Ireland.

"Automatic Pan-Tilt-Zoom Calibration in the Presence of Hybrid Sensor Networks", Christopher R. Wren, Murat Erdem, Ali J. Azarbayejani, Third ACM International Workshop on Video Surveillance and Sensor Networks, Singapore, November 11, 2005.

"Change Detection by Frequency Decomposition: Wave-Back", Fatih Porikli, Christopher R. Wren. Workshop on Image Analysis for Multimedia Interactive Services, April 2005.

"Large Networks of Ultra-low Resolution Sensors in Buildings", Christopher R. Wren. International Conference on Integration of Knowledge Intensive Multi-Agent Systems, pp. 373-389, April 2005

"Waviz: Spectral Similarity for Object Detection" Christopher R. Wren, Fatih Porikli. IEEE International Workshop on Performance Evaluation of Tracking and Surveillance. Breckenridge, CO, USA. January 2005.

"Interactive Projection" Paul Beardsley, Shane Booth, Clifton Forlines, Ramesh Raskar, Jeroen Van Baar and Christopher R. Wren. ACM SIGGRAPH 2004, Emerging Technologies, Los Angeles, CA, USA. August 2004.

"Finding Temporal Patterns by Data Decomposition." David C. Minnen and Christopher R. Wren. IEEE International Conference on Automatic Face and Gesture Recognition, Seoul, Korea, May 2004.

"Self-configuring, Lightweight Sensor Networks for Ubiquitous Computing." Christopher R. Wren and Srinivasa Rao. International Conference on Ubiquitous Computing, pp. 205-206, Seattle, WA, USA, September 2003.

"Parsimony & Transparency in Ubiquitous Interface Design." Christopher R. Wren and Carson J. Reynolds. International Conference on Ubiquitous Computing, pp. 31-33, Göteborg, Sweden, September 2002.

"Browsing 3-D spaces with 3-D vision: body-driven navigation through the Internet City" Flavia Sparacino, Christopher R. Wren, Ali J. Azarbayejani, Alex P. Pentland. Proceedings of 3DPVT: 1st International Symposium on 3D Data Processing Visualization and Transmission, Padova, Italy, June 19-21 2002.

"Volumetric Operations with Surface Margins." Christopher R. Wren, Yuri A. Ivanov. IEEE Computer Vision and Pattern Recognition Technical Sketches, Kauai, HI, December 2001.

"Combining Audio and Video in Perceptive Spaces." Christopher R. Wren, Sumit Basu, Flavia Sparacino, Alex P. Pentland. First International Workshop on Managing Interaction, Dublin, Ireland, December 1999.

"Understanding Purposeful Human Motion." Christopher R. Wren and Alex P. Pentland. 1999 IEEE International Workshop on Modeling People, Kerkyra, Greece, September 20, 1999

"City of News." Flavia Sparacino, Richard DeVaul, Christopher R. Wren, Ronald MacNeil, Gloriana Davenport, Alex P. Pentland. SIGGRAPH 1999, Visual Proceedings, Los Angeles, CA, USA, August 8-13, 1999.

"Augmented Performance in Dance and Theater." Flavia Sparacino, Christopher R. Wren, Glorianna Davenport, Alex P. Pentland. International Dance and Technology, Arizona State University, Feb. 25-28, 1999.

"Digital Circus: a computer-vision based interactive Virtual Studio." Flavia Sparacino, Christopher R. Wren, Glorianna Davenport, Alex P. Pentland IMAGINA, Monte Carlo, Monaco, January 18-20 1999.

"Real-time 3D Motion Capture." Thanarat Horprasert, Ismail Haritaoglu, David Harwood, Larry S. Davis, Christopher R. Wren, Alex P. Pentland. Workshop on Perceptual User Interfaces, San Francisco, CA, USA, November 4-6, 1998

"Dynamic Modeling of Human Motion." Christopher R. Wren and Alex P. Pentland. Proceedings of the Third IEEE International Conference on Automatic Face and Gesture Recognition, Nara, Japan, April 14-16, 1998

"Perceptive Spaces: Learning Dynamic Models of Human Behavior." Christopher R. Wren, Sumit Basu, Alex P. Pentland. Workshop on Perceptual User Interfaces, Banff, Canada, October 19-21, 1997

"Improvisational Theater Space." Flavia Sparacino, Kristin Hall, Christopher R. Wren, Glorianna Davenport, and Alex P. Pentland. The Sixth Biennial Symposium for Arts and Technology, Connecticut College, New London, CT, USA, February 27 - March 2, 1997.

"Pfinder: Real-Time Tracking of the Human Body." Christopher R. Wren, Ali J. Azarbayejani, Trevor Darrell, and Alex P. Pentland. Second IEEE International Conference on Automatic Face and Gesture Recognition, Killington, VT, USA, October 1996.

"Real-time 3-D Tracking of the Human Body." Ali J. Azarbayejani, Christopher R. Wren, Alex P. Pentland. Proceedings of IMAGE'COM 96, Bordeaux, France, May 1996

"HyperPlex: a World of 3D Interactive Digital Movies." Flavia Sparacino, Christopher R. Wren, Alex P. Pentland, Glorianna Davenport. Proc. of IJCAI'95 Workshop on Entertainment and AI/Alife. Montreal, Canada. pp. 77-81. August 1995.

Refereed and Invited Exhibitions

"Buzz: Measuring and Visualizing Conference Crowds" Christopher R. Wren, Yuri A. Ivanov, Darren Leigh, Jonathan Westhues, Mariela Buchin, Tai-Peng Tian, and Pavan Turaga. ACM SIGGRAPH 2007 Emerging Technologies, San Diego, CA, USA. August 2007.

"Ambient Intelligence for Better Buildings." Yuri Ivanov, Christopher Wren, Darren Leigh, Jonathan Westhues, Alexander Sorokin, Ishwinder Kaur. Demonstrations track of the 2006 Neural Information Processing Systems Conference, Vancouver, Canada, December 4, 2006.

"Ambient Intelligence for Better Buildings." Yuri Ivanov, Darren Leigh, Jonathan Westhues, Christopher R. Wren. Mitsubishi Electric Internal Technology Roadshow. Tokyo and Osaka, Japan. August 2006.

"Interacting With Projections Using iLamp Projectors." Paul Beardsley, Shane Booth, Clifton Forlines, Ramesh Raskar, Jeroen Van Baar and Christopher R. Wren. ACM SIGGRAPH 2004 Emerging Technologies, Los Angeles, CA, USA. August 2004.

"Wearable City of News." Flavia Sparacino, Steve Schwartz, Christopher R. Wren, Richard W. DeVaul, Glorianna Davenport, Alex P. Pentland. ACM SIGGRAPH 1999 Millennium Motel, Los Angeles, USA.

"Shall We Dance." Kazuyuki Ebihara, Jun Ohya, Thanarat Horprasert, Ismail Haritaoglu, David Harwood, Larry S. Davis, Christopher R. Wren, Alex P. Pentland. ACM SIGGRAPH 1998 Enhanced Realities, Orlando, FL, USA. July 1998

"Toco the Toucan." Deb Roy, Tony Jebara, Christopher R. Wren, William Tomlinson, Alex P. Pentland. ACM SIGGRAPH 1997 Electric Garden, Los Angeles, CA, USA. August 1997

"Smart Spaces." Ali J. Azarbayejani, Christopher R. Wren, Andrew Wilson, David Becker, Nuria Oliver, Deb Roy, Flavia Sparacino, Francois Berard, Alex P. Pentland. ACM SIGGRAPH 1996 Digital Bayou, New Orleans, LA, USA. August 1996

"Dreams and Illusions." Trevor Darrell, Bruce Blumberg, Michael P. Johnson, Christopher R. Wren, Pattie Maes, Alex P. Pentland. ACM SIGGRAPH 1995, Los Angeles, CA, USA. August 1995

"Trans-Atlantic SURVIVE." Thad Starner, Kenneth Russell, Christopher R. Wren, Martin R. Friedman, Alex P. Pentland. 1994 Schools Lecture, BT Laboratories, Martlesham, England, October 1994.

Patents

Patents may also have been filed in Japan or Europe.
U.S. Patent 10,938,767 "Outputting reengagement alerts by a computing device"
U.S. Patent 10,142,351 "Retrieving contact information based on image recognition, III"
U.S. Patent 10,145,947 "Mapping positions of devices using audio II"
U.S. Patent 9,753,129 "Mapping positions of devices using audio I"
U.S. Patent 9,519,638 "Feed translation for a social network, III"
U.S. Patent 9,454,665 "Retrieving contact information based on image recognition, II"
U.S. Patent 9,449,302 "Generating personalized websites and newsletters"
U.S. Patent 9,148,742 "Proximity detection via audio"
U.S. Patent 9,137,194 "Tools for micro-communities, II"
U.S. Patent 8,818,049 "Retrieving contact information based on image recognition, I"
U.S. Patent 8,694,593 "Tools for micro-communities, I"
U.S. Patent 8,694,445 "Triggering attract mode for devices, II"
U.S. Patent 8,538,742 "Feed translation for a social network, II"
U.S. Patent 8,533,266 "User presence detection and event discovery"
U.S. Patent 8,510,381 "Sharing electronic resources with users of nearby devices"
U.S. Patent 8,447,516 "Efficient proximity detection."
U.S. Patent 8,412,512 "Feed translation for a social network, I"
U.S. Patent 8,401,981 "Triggering attract mode for devices, I"
U.S. Patent 8,149,278 "Modeling Movement with Probabilistic Graphs."
U.S. Patent 7,907,781 "Determining Geometries of Scenes."
U.S. Patent 7,667,730 "Composite Surveillance Camera System."
U.S. Patent 7,619,647 "Context Aware Surveillance System Using a Hybrid Sensor Network."
U.S. Patent 7,542,949 "Efficient Hierarchical Decomposition of Temporal Patterns."
U.S. Patent 7,415,164 "Spectral Similarity for Object Detection."
U.S. Patent 7,359,836 "Scalable Activity Recognition for Sensor Networks."
U.S. Patent 7,302,369 "Traffic and Geometry Modeling with Sensor Networks."
U.S. Patent 7,242,421 "Establishing a communications link by sensing perceptual presence."
U.S. Patent 6,911,995 "Depth Segmentation with Virtual Surface Margins."
U.S. Patent 6,680,745 "Videoconferencing method with tracking of face and dynamic bandwidth allocation."

Keyword Salad

Python, Go, Rust, Java, C++, SQL, JavaScript, Tableau, D3, pandas, geopandas, scipy, numpy, plotly, jupyter, Apache Beam, Matlab, Excel, git, GitHub, cvs, perforce, poetry, npm, docker, kubernetes, Flask, Next.js, React, Android, Linux, Arduino, dynamic systems, stochastics, statistics, recursive models, Kalman filtering, pattern recognition, computer vision, Markov models, information visualization, dashboards, Splunk, Google Analytics, interviewing, promotion committee, team building, recruiting, team culture, knowledge sharing, engineering management, distributed teams, agile methodology, hybrid meetings, Zoom, Teams, Google meet, Webex, Slack, Discord, Mattermost, Signal, mentoring, coaching, stakeholder management, vendor management, change management, system engineering, process optimization, PowerPoint, Mural, Word, Google docs, Google slides, writing, reporting, presenting, lecturing, workshopping, brainstorming, field research, user experience interviews, experiment frameworks, a/b testing, natural experiments, propensity score matching, raking, distributed computing, parallel processing, machine intelligence, artificial intelligence, human computer interface, human factors, privacy, security, differential privacy, zero-knowledge, zero-trust, cryptography, prediction, scheduling, modeling, domestic travel, international travel, engineering design documents, release engineering, post-mortem analysis, rolling deployments, site reliability, unit testing, integration testing, API design, LaTeX