

Yuanzhi Cao

AUGMENTED REALITY HCI RESEARCHER · DESIGNER · MAKER

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As a researcher in the **Human-Computer Interaction (HCI)** area, I specialize in designing interactive systems that provide novel **Augmented Reality (AR)** user experience for intuitive human-machine operations, and expressive human-human skill transfer.

Professional Experience

PTC, full-time

SENIOR INNOVATION ENGINEER AT REALITY LAB

- Researching and exploring novel interactions and system designs of Augmented Reality for industrial applications.

Boston, USA

Nov. 2020 - Now

Microsoft, internship

RESEARCH INTERN AT APPLIED SCIENCE GROUP (ASG)

- Designed and implemented a mobile augmented reality system for user-defined portrait relighting on smartphone
- Collaborated with the team to design the AR face illumination machine learning model and the integrated into Android environment
- Recommended by the manager for future publication and corporate production

Redmond, USA

Jan. 2020 - May. 2020

Education

Purdue University

PH.D. IN THE C DESIGN LAB, MECHANICAL ENGINEERING DEPARTMENT

GPA : 3.86

West Lafayette, USA

Aug. 2015 - Dec. 2020

Indiana University – Purdue University Indianapolis (IUPUI)

M.S. IN MECHANICAL ENGINEERING DEPARTMENT

GPA : 3.91

Indianapolis, USA

Aug. 2013 - May. 2015

Dalian University of Technology (DLUT)

B.S. IN MECHANICAL ENGINEERING DEPARTMENT

GPA : 3.68

Dalian, China

Sep. 2008 - Jun. 2013

Research Experience

- HUMAN-HUMAN SKILL TRANSFER WITH AUGMENTED REALITY

MobileTutAR: a Lightweight AR Tutorial System using Human Segmentation Videos [A.5]

PTC

LEAD AUTHOR

Published at CHI LBW 2022

- System workflow design of creating a lightweight AR tutoring experience with spatially situated 2D and 3D human segmentation
- Featuring human segmentation tutorial authoring, spatial tutorial content placement for 2D canvas, and 3D point-cloud visualization
- The development of the MobileTutAR system on commercially available mobile devices (iPhone 12 and later)

An Exploratory Study of Augmented Reality Presence for Tutoring Machine Tasks [C.7]

Purdue

LEAD AUTHOR

Published at CHI 2020

- Study system design and implementation of a machine task scenario to compare four different AR-based tutor options in parallel, patent applied [H.6]
- Quantitative and qualitative results showing users' objective and subjective responses and tutor preferences
- Recommendations and insights summarized from the results of the study, guiding future machine task tutoring system design

- HUMAN-ROBOT-IOT INTERACTION WITH AUGMENTED REALITY

GhostAR: Time-space Editing for Human-Robot Collaborative Task Authoring [C.6, H.2]

Purdue

LEAD AUTHOR

Published at UIST 2019

- System workflow design with AR ghost as contextual references from role-playing natural embodied interaction, patents applied [H.5]
- Collaboration model design that achieves time-space correlation based on the dynamic time warping (DTW) algorithm
- Interface and interaction design for ghost creation, visualization, editing, and previewing throughout a successful collaborative action

V.Ra: Visual and Spatial Programming for Robot Task Planning [C.5, A.3, H.1]

Purdue

LEAD AUTHOR

Published at DIS 2019, CHI LBW 2019

- System framework design with prototype human-robot-IoT ecosystem for robot task planning with one single SLAM-AR device
- Design and implementation of a mobile-based authoring interface that supports creating, editing, and simulating complex tasks
- Applied for 2 non-provisional patents [H.3, H.4] and commercialized by a start-up DIY modular robotics company, ZIRO

Ani-Bot: A DIY Modular Robotics System Supporting Mixed Reality Interaction [C.2, A.2]

Purdue

LEAD AUTHOR

Published at TEI 2018, UIST poster 2017

- Design of the system workflow supporting Mixed Reality interaction for modular DIY robotics with HMD (HoloLens)
- Design and fabrication of modular DIY robotics kit (30 modules in total) embedded with assembly awareness
- Multi-modal Mixed Reality interactions enabling assembly and iteration guidance, and customization of complex tasks

Teaching Experience

Computer Aided Design and Prototyping (ME444)

Purdue

HEAD TEACHING ASSISTANT & PROJECT COACH

2015-2018 Fall; 2017, 2018 Spring

- In charge of lab session and coached 50+ students with their CAD skills using PTC Creo
- Developed innovative guided-project oriented course content to help students improve their hands-on prototyping skills
- Gave selective lectures and demonstrations for *ideation through sketching*, *design for fabrication*, and *wireless mechatronics control*

Technical Skillset

Augmented Reality	Google ARCore/TangoCore, Microsoft Mixed Reality, Oculus Rift, HTC Vive, Vuforia, OpenCV
Machine Learning	Object Segmentation and Recognition, Human Motion Externalization and Recognition, Reinforcement Learning
Prototyping	Machine Learning (Tensorflow), AR System Development (Unity3D), Robotics (ROS), IoT and Smart Machine (Arduino)
Design	Ideation Sketching, Mechanical Computer-Aided Design, Industrial Design, 3D Rendering and Visualization
Fabrication	3D Printing, Laser Cutting, Hands-on Crafting, Tinkering, Soldering and Welding, CNC Machining
User Experience	Informative Elicitation Study, Iterative Design and Benchmark, Qualitative and Quantitative Evaluation and Analysis

Academic Service

Reviewer CHI 2019-2023, UIST 2019-2023, HRI 2018-2019, DIS 2018-2019, TEI 2018-2019

Volunteer UIST 2017, TEI 2018

Honors & Awards & Patents

[H.6] 2022 US Patent , Adaptive Tutoring System for Machine Tasks in Augmented Reality	Purdue, USA
[H.5] 2021 US Patent , System and method for embodied authoring of human-robot collaborative tasks with AR	Purdue, USA
[H.4] 2019 US Patent , Augmented reality interface for authoring tasks for execution by a programmable robot	Purdue, USA
[H.3] 2019 US Patent , Robot navigation and robot-IoT interactive task planning using augmented reality	Purdue, USA
[H.2] 2019 Best Presentation , Best presentation award at User Interface Software and Technology Symposium (UIST 2019)	New Orleans, USA
[H.1] 2017 Best Implementation , Student contest at User Interface Software and Technology Symposium (UIST 2017)	Quebec, Canada

MAJOR CONFERENCE & JOURNAL & EXTENDED ABSTRACT & THESIS (PEER-REVIEWED)

- C.10** Wang, T., Qian, X., He, F., Hu, X., **Cao, Y.** and Ramani, K., “GesturAR: An Authoring System for Creating Freehand Interactive Augmented Reality Applications.” In The 34th Annual ACM Symposium on User Interface Software and Technology (pp. 552-567). (**UIST 2021**)
- C.9** Huang, G., Qian, X., Wang, T., Patel, F., Sreeram, M., **Cao, Y.**, Ramani, K. and Quinn, A.J., “Adaptutar: An adaptive tutoring system for machine tasks in augmented reality.” In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (**CHI 2021**)
- C.8** T. Wang, X. Qian, F. He, X. Hu, K. Huo, **Y. Cao**, K. Ramani, “CAPturAR: An Augmented Reality Tool for Authoring Human-Involved Context-Aware Applications.” Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology 2020 Oct 20 (pp. 328-341). (**UIST 2020**) (**20.3%** Acceptance Rate)
- C.7** **Y. Cao**, X. Qian, T. Wang, R. Lee, K. Huo, K. Ramani, “An Exploratory Study of Augmented Reality Presence for Tutoring Machine Tasks.” Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (**CHI 2020**) (**23.8%** Acceptance Rate)
- C.6** **Y. Cao**, T. Wang, et al., and K. Ramani, “GhostAR: A Time-space Editor for Embodied Authoring of Human-Robot Collaborative Task with Augmented Reality.” Proceedings of the 32nd Annual Symposium on User Interface Software and Technology (**UIST 2019**) (**24.4%** Acceptance Rate)
- C.5** **Y. Cao**, Z. Xu, et al., and K. Ramani, “V.Ra: An In-Situ Visual Authoring System for Robot-IoT Task Planning with Augmented Reality.” Proceedings of the 2019 Designing Interactive Systems (**DIS 2019**) (**25%** Acceptance Rate)
- C.4** K. Huo, T. Wang, L. Paredes, A. Villanueva, **Y. Cao** and K. Ramani, “SynchronizAR: Instant Synchronization for Spontaneous and Spatial Collaborations in Augmented Reality.” Proceedings of the 31st Annual Symposium on User Interface Software and Technology (**UIST 2018**) (**22.5%** Acceptance Rate)
- C.3** K. Huo, **Y. Cao**, S. Yoon, Z. Xu, G. Chen, K. Ramani, “Scenariot: Spatially Mapping Smart Things Within Augmented Reality Scenes.” Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (**CHI 2018**) (**25%** Acceptance Rate)
- C.2** **Y. Cao**, Z. Xu, T. Glenn, K. Huo, K. Ramani, “Ani-Bot: A Modular Robotics System Supporting Creation, Tweaking, and Usage with Mixed-Reality Interactions.” Proceedings of the 12th International Conference on Tangible, Embedded, and Embodied Interaction (**TEI 2018**) (**28%** Acceptance Rate)
- C.1** M. Liu, Y. Zhang, J. Bai, **Y. Cao**, J. M. Alperovich, K. Ramani. “WireFab: Mix-Dimensional Modeling and Fabrication for 3D Mesh Models.” Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems. ACM, (**CHI 2018**) (**25%** Acceptance Rate)
- A.5** **Y. Cao**, A. Fuste, V. Heun. “MobileTutAR: a Lightweight Augmented Reality Tutorial System using Spatially Situated Human Segmentation Videos.” In Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems, ACM, 2022.
- A.4** Ipsita, A., Li, H., Duan, R., **Cao, Y.**, Chidambaram, S., Liu, M. and Ramani, K. “VRFromX: From Scanned Reality to Interactive Virtual Experience with Human-in-the-Loop.” In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems, ACM, 2021.
- A.3** **Y. Cao**, Z. Xu, F. Li, W. Zhong, K. Huo, and K. Ramani. “V. Ra: An In-Situ Visual Authoring System for Robot-IoT Task Planning with Augmented Reality.” In Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems, ACM, 2019.
- A.2** **Y. Cao**, Z. Xu, T. Glenn, K. Huo, K. Ramani, “Ani-Bot: A Mixed-Reality Modular Robotics System”, Adjunct Proceedings of the 31th Annual Symposium on User Interface Software and Technology , 119-121, 2017.
- A.1** **Y. Cao**, et al., and L. Zhu, “Development of a Microfluidic Gas Generator From an Efficient Film-based Microfabrication Method”. 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences, MicroTAS 2014.

- J.1** **Y. Cao**, Jacob Bontrager-Singer, and Likun Zhu. "A 3D microfluidic device fabrication method using thermopress bonding with multiple layers of polystyrene film". *Journal of Micromechanics and Microengineering* 25.6 (2015): 065005.
- T.1** **Y. Cao**, "The development of polystyrene based microfluidic gas generation system". Indian University - Purdue University Indianapolis, M.S., Thesis, 2015