

# Xun Qian

HCI RESEARCHER | AR/VR/XR DEVELOPER

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## Professional Experience

### Research Intern at Google

INTERN HOST: DR. RUOFEI DU; CO-HOST: DR. FEITONG TAN

San Francisco, CA

Sep. 2022 - Dec. 2022

### Research Scientist Intern at Meta Reality Labs

INTERN MANAGER: DR. KASHYAP TODI

Redmond, WA

May. 2022 - Sep. 2022

## Education

### Purdue University

PH.D. CANDIDATE, GPA: 3.7/4.0

- Lead researcher in developing **AI-driven and context-aware AR/VR/XR systems**. Advisor: Dr. Karthik Ramani.
- Published **5** lead-author research papers in CHI and UIST. Co-authored **6** papers in top-tier HCI venues. Got **2** Patent Applications.
- **4** co-authored papers have been conditionally accepted in *CHI 2023*.

West Lafayette, IN

Aug. 2018 - Present

### Cornell University

M.ENG. DEGREE, GPA: 3.7/4.0

### University of Science and Technology Beijing (USTB)

B.S. DEGREE, GPA: 3.8/4.0

Ithaca, NY

Aug. 2016 - Jan. 2018

Beijing, China

Sep. 2012 - Jun. 2016

## Research Experience

### AI-DRIVEN AND CONTEXT-AWARE AR/VR/XR SYSTEMS

#### ARnnotate: An Augmented Reality Interface for Collecting Custom Dataset of 3D Hand-Object Interaction Pose Estimation [C.1]

LEAD AUTHOR

- Implemented a **CenterPose object detection network** and an **OpenPose hand detection network** using *Tensorflow* on Linux.
- Developed an AR-based workflow for pervasive and continuous collection of custom hand-object pose estimation datasets.
- Designed an AR interface with front-end visual assistance and back-end computational processes that helps improve the quality of the datasets using *Unity3D* on *Oculus Quest 2*.

West Lafayette, IN

Published in UIST 2022

#### ScalAR: Authoring Semantically Adaptive Augmented Reality Experiences in Virtual Reality [C.3]

LEAD AUTHOR

- Integrated a **3D semantic understanding network** and a **YOLO object detection network** for 3D object detection on *HoloLens 2*.
- Developed an AR/VR integrated workflow to define and validate semantically adaptive AR experiences in synthetically generated VR environments.
- Constructed an **SVM-based algorithm** that fits an AR designer's demonstrations as a semantic adaptation model used for deploying the experiences.
- Designed an AR interface for physical environment scanning, an immersive VR authoring studio for experience authoring, and an AR interface for experience deployment using *Unity3D* on *Oculus Quest 2*.

West Lafayette, IN

Published in CHI 2022

#### GesturAR: An Authoring System for Creating Freehand Interactive Augmented Reality Applications [C.4] [Honorable Mention Award (Top 5%)]

CO-LEAD AUTHOR

- Implemented a **CNN for gesture detection** and a **Siamese network for gesture comparison** using *PyTorch* and *Unity Barracuda*.
- Proposed a workflow for customizing freehand interactive AR experiences through in-situ gesture demonstration and visual programming.
- Designed an interaction model that mapped the gestural inputs to the virtual content behaviors with 4 different interaction modes.
- Developed an AR interface for performing hand gestures and defining virtual content reactions using *Unity3D* on *HoloLens 2*.

West Lafayette, IN

Published in UIST 2021

## AdapTutAR: An Adaptive Tutoring System for Machine Tasks in Augmented Reality [C.6, P.1]

West Lafayette, IN

CO-LEAD AUTHOR

Published in CHI 2021

- Integrated a **CNN for machine state recognition**, a **CNN for interaction detection**, and an **SVM for user state classification** using *Tensorflow*.
- Developed an AR machine task tutoring system that adjusted the visual presence of the tutoring elements to the user's learning progress.
- Designed a **finite state machine** to dynamically adjust the level of details of the AR tutoring contents based on the detected states.
- Implemented an AR interface for embodying recording the tutoring elements and adaptively showing/hiding them using *Unity3D*.

## CAPturAR: An Augmented Reality Tool for Authoring Human-Involved Context-Aware Applications [C.8, P.2]

West Lafayette, IN

CO-LEAD AUTHOR

Published in UIST 2020

- Designed a **3D human upperbody skeleton detection network** with fisheye images using *Tensorflow*.
- Developed an automatic dataset labelling application for the pose detection network using *Azure Kinect Body Tracking SDK*.
- Proposed a system for personalizing human-involved context-aware applications (CAPs) in AR using the recorded daily activities.
- Developed a multi-camera AR-HMD platform supporting the non-intrusive recording and detection of the human activities.
- Implemented a **Dynamic Time Warping algorithm** for comparing human activities in real-time.
- Built an AR interface for visualizing and selecting the recorded contexts, and creating CAPs through visual programming using *Unity3D*.

## HUMANS, HARDWARES, AND ROBOTICS

### MechARspace: An Authoring System Enabling Bidirectional Binding of AR with Toys in Real-time [C.2]

West Lafayette, IN

CO-AUTHOR

Published in UIST 2022

- Proposed an AR-based workflow that enables end-users to author AR-enhanced interactive toys.
- Designed and manufactured a series of plug-and-play IoT-enabled modular toolkits with sensing and actuating capabilities to achieve physical-AR bidirectional interactions.
- Developed an authoring interface for customizing AR-toy interactions through in-situ demonstration and visual programming.

### An Exploratory Study of Augmented Reality Presence for Tutoring Machine Tasks [C.9]

West Lafayette, IN

CO-AUTHOR

Published in CHI 2020

- Conducted a 32-user systematic study to evaluate the effectiveness of animated human avatars in AR machine task tutorials.
- Designed a mock-up machine with 9 types of machine interfaces and 4 machine tasks with 36 steps to mimic the real-life machine operations.
- Implemented an authoring interface to create AR tutorials with avatars and content animations through embodied demonstration using *Unity3D*.
- Distilled design recommendations and insights for AR machine task tutoring system design from the quantitative and qualitative results.

### Vipo: Spatial-Visual Programming with Functions for Robot-IoT Workflows [C.10]

West Lafayette, IN

CO-AUTHOR

Published in CHI 2020

- Designed an RDF-based protocol to enable the rapid registration of the robots and IoTs and the function-oriented robot-IoT task programming.
- Developed a bi-directional robot-IoT communication system for task deployment and real-time visual feedback using *ROS*.

### GhostAR: A Time-Space Editor for Embodied Authoring of Human-Robot Collaborative (HRC) Tasks with Augmented Reality [C.11]

West Lafayette, IN

CO-AUTHOR

Published in UIST 2019

- Proposed a workflow for authoring HRC tasks by sequentially role-playing the human and robot parts using AR avatars as spatial references.
- Designed a collaborative model for spatio-temporally mapping the real-time human actions to the authored robot reactions.
- Developed an AR interface for avatar recording and edit, robot manipulation, and human-robot collaborative task creation using *Unity3D*.
- Constructed the ROS-AR communication for realistic robot behavior simulation in AR using *customized URDF* and *ROS Sharp*.

## Technical Skills

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<b>AR/VR/XR Development</b>	<b>Unity3D (5 years)</b> ; HoloLens 2, Quest series
<b>Deep Learning</b>	<b>Tensorflow (6 years)</b> , PyTorch; Object Detection, Gesture Detection, Human Pose Detection
<b>Vision and Graphics</b>	OpenCV; WebGL, Three.js
<b>Programming Languages</b>	<b>Python (8 years)</b> , <b>C# (5 years)</b> , Javascript, C++
<b>Design and Prototyping</b>	<b>Solidworks (8 years)</b> ; ROS, Arduino; 3D Printing

## Design and Prototyping Projects

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### LightPaintAR: Assist Light Painting Photography with Augmented Reality [C.7]

West Lafayette, IN

Co-Author

Published in CHI 2021 LBW

- Developed an assist light painting system to facilitate the accurate 3D light source movements by spatially referring to the pre-sketched AR traces.
- Designed an AR interface for in-situ sketching and editing the AR traces using *Unity3D* and *MRTK* on *Hololens2*.

### High-Precision Alignment Tool for E-beam Lens Assembly

Ithaca, NY

ME Co-op

Aug. 2016 - Jan. 2018

- Developed an automatic alignment prototype for e-beam lens assembly using *Hall Effect sensors* and *electromagnetic actuators*.
- Designed and assembled a test apparatus for friction model calibration using the *diffraction grating method*.
- Achieved  $1\mu m$  resolution by tuning the PD control system.

## Teaching Experience

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### Product and Process Design (ME553)

West Lafayette, IN

Teaching Assistant

Fall 2019, Spring 2020

- Restructured the course contents into multiple online modules to improve the overall teaching effectiveness.
- Guided 6+ groups (40+ graduate students) regarding the product opportunity identification and the value proposition of the course project.
- Achieved the highest course rating score (4.6/5.0) in the Fall 2019 semester.

### Computer Aided Design and Prototyping (ME444)

West Lafayette, IN

Teaching Assistant

Spring 2019

- Coached 60+ undergraduate students with 3D prototyping skills using PTC Creo during the lab sessions.
- Designed a racing car guided project aiming to improve students' innovative thinking and the capability of design-from-scratch.
- Organized a toy fair with 100+ participants at the end of the semester.

## Honors and Awards

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Nov. 2021 **Special Recognition for Outstanding Review**, The ACM Conference on Human Factors in Computing Systems (CHI 2022)

West Lafayette, IN

Oct. 2021 **Honorable Mention**, The ACM Symposium on User Interface Software and Technology (UIST 2021)

West Lafayette, IN

## Academic Service

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**Reviewer** CHI 2021-2023, IEEE VR 2022-2023, UIST 2021-2022, CSCW 2022, TEI 2022, SUI 2021, DIS 2021, CHI LBW 2020-2022

## Publications and Patents

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- [C.1]** **Xun Qian\***, Fengming He\*, Xiyun Hu, Tianyi Wang, and Karthik Ramani. 2022. ARnnotate: An Augmented Reality Interface for Collecting Custom Dataset of 3D Hand-Object Interaction Pose Estimation. In Proceedings of the 35th Annual ACM Symposium on User Interface Software and Technology (**UIST 2022**). DOI: <https://doi.org/10.1145/3526113.3545663>
- Zhengzhe Zhu\*, Ziyi Liu\*, Tianyi Wang, Youyou Zhang, **Xun Qian**, Pashin Farsak Raja, Ana M Villanueva, and Karthik Ramani. 2022.
- [C.2]** MechARspace: An Authoring System Enabling Bidirectional Binding of AR with Toys in Real-time. In Proceedings of the 35th Annual ACM Symposium on User Interface Software and Technology (**UIST 2022**). DOI: <https://doi.org/10.1145/3526113.3545668>
- Xun Qian**, Fengming He, Xiyun Hu, Tianyi Wang, Ananya Ipsita, and Karthik Ramani. 2022. ScalAR: Authoring Semantically Adaptive Augmented Reality Experiences in Virtual Reality. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (**CHI 2022**). DOI: <https://doi.org/10.1145/3491102.3517665>
- [C.3]** Augmented Reality Experiences in Virtual Reality. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (**CHI 2022**). DOI: <https://doi.org/10.1145/3491102.3517665>
- Tianyi Wang\*, **Xun Qian\***, Fengming He, Xiyun Hu, Yuanzhi Cao, and Karthik Ramani. 2021. GesturAR: An Authoring System for Creating Freehand Interactive Augmented Reality Applications. In Proceedings of the 34th Annual ACM Symposium on User Interface Software and Technology (**UIST 2021**). DOI: <https://doi.org/10.1145/3472749.3474769>
- [C.4]** Freehand Interactive Augmented Reality Applications. In Proceedings of the 34th Annual ACM Symposium on User Interface Software and Technology (**UIST 2021**). DOI: <https://doi.org/10.1145/3472749.3474769>
- Subramanian Chidambaram, Hank Huang, Fengming He, **Xun Qian**, Ana M Villanueva, Thomas S Redick, Wolfgang Stuerzlinger, and Karthik Ramani. 2021. ProcessAR: An augmented reality-based tool to create in-situ procedural 2D/3D AR Instructions. In Designing Interactive Systems Conference 2021 (**DIS 2021**). DOI: <https://doi.org/10.1145/3461778.3462126>
- [C.5]** Karthik Ramani. 2021. ProcessAR: An augmented reality-based tool to create in-situ procedural 2D/3D AR Instructions. In Designing Interactive Systems Conference 2021 (**DIS 2021**). DOI: <https://doi.org/10.1145/3461778.3462126>
- Gaoping Huang\*, **Xun Qian\***, Tianyi Wang, Fagun Patel, Maitreya Sreeram, Yuanzhi Cao, Karthik Ramani, and Alexander J. Quinn. 2021.
- [C.6]** 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**). DOI: <https://doi.org/10.1145/3411764.3445283>
- Tianyi Wang, **Xun Qian**, Fengming He, and Karthik Ramani. 2021. LightPaintAR: Assist Light Painting Photography with Augmented Reality. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (**CHI EA 2021**). DOI: <https://doi.org/10.1145/3411763.3451672>
- [C.7]** Reality. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (**CHI EA 2021**). DOI: <https://doi.org/10.1145/3411763.3451672>
- Tianyi Wang\*, **Xun Qian\***, Fengming He, Xiyun Hu, Ke Huo, Yuanzhi Cao, and Karthik Ramani. 2020. CAPturAR: An Augmented Reality Tool for Authoring Human-Involved Context-Aware Applications. In Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology (**UIST 2020**). DOI: <https://doi.org/10.1145/3379337.3415815>
- [C.8]** Tool for Authoring Human-Involved Context-Aware Applications. In Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology (**UIST 2020**). DOI: <https://doi.org/10.1145/3379337.3415815>
- Yuanzhi Cao, **Xun Qian**, Tianyi Wang, Rachel Lee, Ke Huo, and Karthik Ramani. 2020. An Exploratory Study of Augmented Reality Presence for Tutoring Machine Tasks. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (**CHI 2020**). DOI: <https://doi.org/10.1145/3313831.3376688>
- [C.9]** Presence for Tutoring Machine Tasks. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (**CHI 2020**). DOI: <https://doi.org/10.1145/3313831.3376688>
- Gaoping Huang, Pawan S. Rao, Meng-Han Wu, **Xun Qian**, Shimon Y. Nof, Karthik Ramani, and Alexander J. Quinn. 2020. Vipo: Spatial-Visual Programming with Functions for Robot-IoT Workflows. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (**CHI 2020**). DOI: <https://doi.org/10.1145/3313831.3376670>
- [C.10]** Spatial-Visual Programming with Functions for Robot-IoT Workflows. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (**CHI 2020**). DOI: <https://doi.org/10.1145/3313831.3376670>
- Yuanzhi Cao\*, Tianyi Wang\*, **Xun Qian**, Pawan S. Rao, Manav Wadhawan, Ke Huo, and Karthik Ramani. 2019. GhostAR: A Time-space Editor for Embodied Authoring of Human-Robot Collaborative Task with Augmented Reality. In Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (**UIST 2019**). DOI: <https://doi.org/10.1145/3332165.3347902>
- [C.11]** Editor for Embodied Authoring of Human-Robot Collaborative Task with Augmented Reality. In Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (**UIST 2019**). DOI: <https://doi.org/10.1145/3332165.3347902>
- [P.1]** Karthik Ramani, Gaoping Huang, Alexander J. Quinn, Yuanzhi Cao, Tianyi Wang, and **Xun Qian**. 2022. Adaptive Tutoring System for Machine Tasks in Augmented Reality. U.S. Patent Application No. 17/517,949.
- [P.2]** Karthik Ramani, Tianyi Wang, and **Xun Qian**. 2021. System and Method for Authoring Human-Involved Context-Aware Applications. U.S. Patent Application No. 17/363,365.