

Xun Qian

HCI RESEARCHER | AR/VR/MR/XR DEVELOPER

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Professional Experience

Research Intern at Google

INTERN MANAGER: DR. RUOFEI DU

San Francisco, CA

Sep. 2022 - Present

Research Scientist Intern at Meta Reality Labs

INTERN MANAGER: DR. KASHYAP TODI

Redmond, WA

May. 2022 - Sep. 2022

Education

Purdue University

PH.D. CANDIDATE IN MECHANICAL ENGINEERING, GPA: 3.6/4.0

- Research Assistant at C Design Lab. Advisor: Dr. Karthik Ramani

West Lafayette, IN

Aug. 2018 - Present

Cornell University

M.ENG. IN MECHANICAL ENGINEERING, GPA: 3.7/4.0

Ithaca, NY

Aug. 2016 - Jan. 2018

University of Science and Technology Beijing (USTB)

B.S. IN MECHANICAL ENGINEERING, GPA: 3.8/4.0

- Exchange student in Mechanical Engineering at University of California, Berkeley; Aug. 2015 - Dec. 2015; GPA: 3.9/4.0

Beijing, China

Sep. 2012 - Jun. 2016

Research Experience

AI-DRIVEN AND CONTEXT-AWARE AR APPLICATIONS

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

LEAD AUTHOR

- Developed an AR-based sequential 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* and *Oculus Quest 2*.
- Implemented a 3D object detection model and a hand detection model on the user-collected datasets using *Tensorflow* and evaluated the model performance.

West Lafayette, IN

Published in *UIST 2022*

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

LEAD AUTHOR

- Developed an AR/VR integrated workflow for collecting physical scenes, defining and validating semantically adaptive AR experiences in synthetically generated VR environments, and deploying the experiences in different physical scene.
- 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* and *Oculus Quest 2*.
- Constructed an AI algorithm that fits an AR designer's demonstrations as a semantic adaptation model used for AR experience deployment.

West Lafayette, IN

Published in *CHI 2022*

GesturAR: An Authoring System for Creating Freehand Interactive Augmented Reality Applications [C.4]

CO-LEAD AUTHOR

- 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.
- Built a CNN for gesture classification and a Siamese one-shot learning network for gesture comparison using *PyTorch* and *Unity Barracuda*.
- Developed an AR interface for performing hand gestures and defining virtual content reactions using *Unity3D* and *MRTK* on *Hololens2*.

West Lafayette, IN

Published in *UIST 2021*

CAPtAR: 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 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 the real-time detection of the activities and contexts.
- Built a CNN for 3D human upperbody pose detection with RGB fisheye images and an object detection network using *Tensorflow*.
- Implemented an AR interface for visualizing and selecting the recorded contexts, and creating CAPs through visual programming using *Unity3D*.
- Developed an automatic labelling system for pose detection network using *Azure Kinect Body Tracking SDK*.

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.

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*.

USER EXPERIENCE IN AR

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

- Developed an AR machine task tutoring system that adjusted the visual presence of the tutoring elements to the user's learning progress.
- Trained a CNN for machine state recognition, a CNN for interaction detection and an SVM for user state classification using *Tensorflow*.
- 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*.
- Evaluated the effectiveness of the system by comparing the learning outcome with a non-adaptive baseline through a 24-user systematic study.

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.

Design and Prototyping Projects

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

ME Co-op

Ithaca, NY

Aug. 2016 - May. 2017

- 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

Product and Process Design (ME553)

TEACHING ASSISTANT

West Lafayette, IN

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)

TEACHING ASSISTANT

West Lafayette, IN

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.

Technical Skills

AR/VR Development	Unity3D, MRTK, Vuforia; HoloLens 2, Meta Quest 2, ZED
Machine Learning	Tensorflow, PyTorch; Object Detection, Human Skeleton Detection, Semantic Segmentation, CNN, PCA, SVM
Computer Vision	OpenCV; Leap Motion; Image Processing, Feature Extraction, Scene Reconstruction, Camera Calibration
Computer Graphics	WebGL, OpenGL, Three.js
Design and Prototyping	ROS, Arduino, 3D Printing, Laser Cutting, Machine Tools, CNC Machining, Solidworks, Creo, AutoCAD
Programming Languages	C#, Python, Javascript, C/C++

Honors and Awards

- 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

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

- [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.