# Danhua Zhang

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## RESEARCH INTERESTS

Focused on **3D user interface design** for mixed reality applications, particularly in interdisciplinary fields, my work to date has addressed challenges in **virtual reality (VR)** and **human-computer interaction (HCI)**, developing user interfaces for applications in virtual agents, healthcare, education, training, social behavior, and motion sickness. Building on this foundation, ***I am now shifting my research toward integrating artificial intelligence and multimodal sensing to enable more adaptive and intelligent virtual agents***. My future work will explore how AI-driven models can enhance virtual agent capabilities by leveraging multimodal data—including speech, vision, and gesture—to create more natural, personalized, and context-aware interactions in immersive environments.

## EDUCATION

**University of Minnesota Twin Cities**, Minneapolis, MN — Sep. 2019 — Present
Ph.D in Computer Science

**University of Minnesota Twin Cities**, Minneapolis, MN — Sep. 2017 — Dec. 2020
M.S in Computer Science

**Sun Yat-sen University**, Guangzhou, China — Aug. 2013 — June 2017
B.S in Information and Computing Science

## SKILLS

- Programming: C/C++, C#, Python, PyTorch, TypeScript, JavaScript
- Game Engine: Unity, Unreal Engine
- XR Tools: OpenXR, VRPN, Photon PUN 2
- 3D Graphics & Modeling: GLSL/HLSL, Blender, Character Creator, iClone, Maya
- Methodologies: user experience research, quantitative & quanlitative analysis, data visualization

## SELECTED PUBLICATIONS

- Nie, T., Hutton, C., Cantory, V., **Zhang, D.**, DeGuzman, J., Interrante V., Adhanom I., and Rosenberg, E.S. (2025). Peripheral teleportation: A rest frame design to mitigate cybersickness during virtual locomotion. IEEE Transactions on Visualization and Computer Graphics, 31(5), 2891–2900.
- Huang, Y., **Zhang, D.** and Rosenberg, E.S., (2024). Direction-based authentication: Combining symbolic input and contextual cues for virtual reality password entry. 2024 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 681–689.
- Huang, Y., **Zhang, D.** and Rosenberg, E.S. (2023). DBA: Direction-based authentication in virtual reality. 2023 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), 953–954.
- **Zhang, D.**, Khadar, M., Schumacher, B., Raveendra, M., Adeniyi, S., Wu, F., Aseeri, S. and Rosenberg, E.S. (2021). Covid-vision: A virtual reality experience to encourage mindfulness of social distancing in public spaces. 2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), 697–698.

## RESEARCH EXPERIENCE

**Interaction with 3D Virtual Agent in VR** — *June 2024 - Present*

- Developed a framework integrating 5 models, including 3 LLM-based models with distinct functionalities to process multi-modal input data, enabling spatial and verbal interaction with a 3D virtual agent in VR.
- Deployed the framework on a scalable server infrastructure, enabling real-time interactions with low latency.
- Built a VR environment with interactive 3D avatars, designed to support natural communication and spatial interaction for immersive user experiences.

**Knee Surgery Training in VR** — *June 2023 - Dec. 2023*

- Collaborated with 2 orthopedic experts to build a novel training system for a specialized knee surgery procedure in VR, recognized by the university's board of regents for its innovation.
- Created a virtual operation room scenario in Unity with 12+ customized 3D medical instrument models in Blender, enhancing immersion for surgical training.
- Developed an interactive video system with automatic pauses at 8 key critical learning points, panels with knowledge point summary, manual interaction with instruments and anatomy model, received high evaluation scores from 6 surgeons compared to commercial alternatives.

**VR Authentication with Evaluation** *Jan. 2023 - Oct. 2023*

- Designed a novel VR authentication method combining symbolic input and contextual cues.
- Created a 3D interactive compass with directions as passwords using Unreal Engine.
- Conducted a mixed-method multi-session user study with 32 participants to evaluate efficiency, memorability and security metrics.
- *Published a paper in IEEE ISMAR 2024 as co-first author.*

**Virtual Patient Simulation for Nurse Training** *Sept. 2021 - Present*

- Cooperated with nursing experts to design a VR system for evaluating nursing competency.
- Developed two interactive VR nurse training scenarios in Unity with customized patient avatars with natural communication capabilities, enabling real-time verbal feedback to users for a realistic training experience.
- Designed the interview questions and interviewed participants for their qualitative feedback on the application as well as quantitative subjective evaluation.
- Conducted two mixed-method user studies iterative design, and evaluated the system with 18 nursing students, resulting in a 45% increase in confidence and improved procedural skills, critical thinking and decision-making.

**Communication Technology & Social Behavior in VR** *Sept. 2020 - Present*

- Partnered with psychologists to study social behavior differences between web-conferencing and VR.
- Deployed a multi-user VR application to Oculus Quest with Unity/C#, supporting voice and animation synchronization using Photon PUN 2.
- Built a variant application with host privilege to control the VR users on Windows & MacOS.
- Trained 10+ undergraduate research assistants to use the developed system.

**Motion Sickness: Postural Sway Analysis in VR** *Sept. 2019 - May. 2020*

- Teamed up with kinesiologists to analyze postural sway patterns when users' motion sickness level change.
- Programmed a software collecting raw data from a balance board for postural sway measurement.
- Wrote a software capable of collecting raw data from most commercial VR devices.

## Teaching & Mentoring Experience

**Graduate Teaching Assistant (University of Minnesota)** *Sep. 2022 – Present*

- CSCI 5609 Visualization (Spring 2025)
- CSCI 2033 Linear Algebra (Fall 2024)
- CSCI 4611 Programming Interactive Computer Graphics and Games (Spring 2024)
- CSCI 4511W Introduction to Artificial Intelligence (Fall 2022 - Spring 2023)

## Peer Reviews

- 2025 ACM CHI, ACM VRST, IEEE VR, IEEE ISMAR
- 2024 ACM CHI, ACM VRST, ACM SUI, IEEE VR, IEEE ISMAR
- 2023 UbiComp/ISWC - ISWC Notes and Briefs

## Reference Letters

Prof. Evan Suma Rosenberg (Ph.D. advisor): Associate Professor, UMN
Email: suma@umn.edu