Zhehan Qu

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RESEARCH INTERESTS

My research focuses on designing, deploying, and evaluating **AI-driven systems for safe Augmented Reality (AR)**. I conduct empirical **user studies** to analyze attention patterns and build **deep learning models** that leverage **eye tracking** to infer **user attention and cognitive states**. These models drive adaptive AR interfaces designed to **mitigate safety risks in real-time** across domains such as medical training and human-robot interaction. Additionally, I integrate large vision models for **robust AR scene understanding**, utilizing **edge computing** to facilitate efficient system deployment.

EDUCATION

Duke University Aug. 2022 – Present

Ph.D. Candidate, Computer Science Durham, NC, USA

- **Selected Courses**: Theory & Algorithms of Machine Learning, Causal Analysis, Edge Computing, Computer Networks
- **GPA**: 4.0/4.0
- **Advisor**: Prof. Maria Gorlatova

Shanghai Jiao Tong University Sep. 2018 – June 2022

Bachelor, Computer Science and Engineering (IEEE Honor Class) Shanghai, China

- **Selected Courses**: Algorithms, Discrete Math, Programming Language, Data Science, Natural Language Processing
- **GPA**: 3.8/4.3

SELECTED RESEARCH

Modeling Situational Awareness in AR-Guided CPR Oct. 2024 – Oct. 2025

Intelligent Interactive Internet of Things Lab Duke University

- Designed and implemented an AR application for **AR-Guided cardiopulmonary resuscitation** (CPR), along with simulated bleeding and vomiting incidents to evaluate **situational awareness** of CPR providers using AR guidance.
- In a **user study with 30 users**, identified that **slower and shorter saccades** and **longer time fixated on virtual content** were correlated with poor situational awareness, measured by whether the incidents were detected and handled properly.
- Designed a **graph neural network** that represents fixations as nodes and spatial-temporal relationships between fixations as edges, achieving **83% accuracy** in predicting situational awareness based on 7s of eye tracking data.
- Paper accepted to **IEEE ISMAR 2025**, a leading conference in the field of augmented and virtual reality.

Analyzing and Predicting the Distraction Potential of Augmented Reality July 2023 – Sept. 2025

Intelligent Interactive Internet of Things Lab Duke University

- Developed a **Sudoku helper** application for **AR** and **VR** to study user attention, incorporating step-by-step guidance and controlled visual distractions.
- Conducted a **comparative user study with 38 users** in AR and VR, revealing through **gaze data analysis** that VR simulations induced a **higher perceptual load** and reduced user focus, while AR increased **cognitive load**, as indicated by **increased fixation duration and decreased fixation rate**.
- Trained **time-series Transformers** on eye tracking data to predict the presence of distractors and assess user attentional control.
- Paper accepted to **IEEE ISMAR 2024**

Gaze-Prompted Segment Anything on AR Headset Feb. 2023 – April 2023

Intelligent Interactive Internet of Things Lab Duke University

- Deployed the Segment Anything Model (SAM) on a Magic Leap 2, using gaze data to prompt SAM for near real-time segmentation of objects in the user's field of view.

- Compared the performance of device-based (via Unity Sentis) and edge-based implementations, implemented a separate-encoding pipeline to reuse image encoders and reduce latency, with mimimal loss of accuracy.

Readability Controlled Open-Domain Question-Answering System on COVID-19 Feb. 2021 – May 2021
AI+X Project-Based Learning, NLP Program MIT & Touch EdTech

- Built an open-domain **question-answering** (QA) system based on RAG structure, which enables control of the readability of the answer
- Prepended readability scores to sentences to fine-tune BART, the generator part of RAG, following the CTRL manner; modified the retriever of RAG by adding a score of readability match in addition to similarity check

Internship

Gematria Technologies Sept. 2021 – Jan. 2022
Intern Remote

- Worked on processing news articles with various tools related to **Natural Language Processing**, including named entity recognition (NER), co-reference resolution, entity linking and sentiment analysis. The work aimed at discovering the sentiment of a given topic in news reports in a certain time period, and further exploiting the information for predicting trends in the stock market

HONORS

Best Doctoral Consortium Presentation Honorable Mention *Oct. 2024*
NSF AI Spring School Applied AI Poster Award *Mar. 2024*

SKILLS

Programming: Python, C#, C++, Kotlin
Machine Learning & Deep Learning: TensorFlow, Scikit-Learn, PyTorch, Hugging Face Transformers
Tools & Frameworks: Unity (MRTK, Magic Leap SDK, OpenXR), Vuforia, Pandas, Pingouin, pymer4, lme4

Publications

Conference Proceedings

- **[VRST25]** S. Baek, **Z. Qu**, M. Gorlatova, AR-TMT: Investigating the Role of Distraction Type and Attention Control in AR Visual Search. To be presented at ACM VRST, Nov. 2025. Code: https://github.com/Duke-I3T-Lab/AR-TMT
- **[ISMAR25a] Z. Qu**, T. Hu, C. Fronk, M. Gorlatova, Will You Be Aware? Eye Tracking–Based Modeling of Situational Awareness in Augmented Reality. To be presented at IEEE ISMAR, Oct. 2025.
  Video demo: https://www.youtube.com/watch?v=wGF_hvBP-hg; Code: https://github.com/Duke-I3T-Lab/AR_CPR_SA
- **[ISMAR25b]** T. Hu, T. Du, **Z. Qu**, M. Gorlatova, Spatial Sensing Evaluation for Multiple XR Devices. To be presented at IEEE ISMAR, Oct. 2025. Code: https://github.com/Duke-I3T-Lab/XR_Tracking_Evaluation
- **[ISMAR24] Z. Qu**, R. Byrne, and M. Gorlatova, "Looking" into Attention Patterns in Extended Reality: An Eye Tracking–Based Study. In Proc. IEEE ISMAR, Oct. 2024.
  Video demo: https://www.youtube.com/watch?v=KJo9mlpy4hQ; Code: https://github.com/Duke-I3T-Lab/XR_Attention_Sudoku
- **[IPSN24]** L. Duan, Y. Chen, **Z. Qu**, M. McGrath, E. Ehmke, M. Gorlatova, BiGuide: A Bi-Level Data Acquisition Guidance for Object Detection on Mobile Devices. In Proc. ACM/IEEE IPSN, May 2024. (**21.5% acceptance rate**). **IEEE/ACM IPSN Best Research Artifact Runner-up Award**. Code: https://github.com/BiGuideCollection/BiGuide

Workshop Proceedings

- **[IEEEVRW24]** S. Eom, T. Ma, N. Vutakuri, A. Du, **Z. Qu**, J. Jackson, M. Gorlatova, Did You Do Well? Real-Time Personalized Feedback on Catheter Placement in Augmented Reality-Assisted Neurosurgical Training. In Proc. IEEE VR Abstracts and Workshops, Mar. 2024.
- **[ISMARDC24] Z. Qu**, Doctoral Consortium: Attention-Safe Augmented Reality System with Edge Computing. In Proc. IEEE ISMAR-Adjunct, Oct. 2024. **Best Doctoral Consortium Presentation Honorable Mention**.

Conference Demonstrations and Poster Presentations

- **[XRSecurity25] Z. Qu**, T. Hu, M. Gorlatova, Demo: More Than Just Compressions: Attentional Tunneling in Augmented Reality–Guided Cardiopulmonary Resuscitation. To be presented at the First Workshop on Enhancing Security, Privacy, and Trust in Extended Reality (XR) Systems, Oct. 2025.
  Video: https://www.youtube.com/watch?v=2MfYJF6sW8A
- **[IEEEVRW24]** R. Byrne, **Z. Qu**, C. Fronk, S. Eom, T. Scargill, M. Gorlatova, AR Simulations in VR: The Case for Environmental Awareness. In Proc. IEEE VR Abstracts and Workshops, Mar. 2024.