Zhehan Qu

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RESEARCH INTERESTS

AI-assisted safe Augmented Reality (AR) systems, using eye tracking and machine learning for user context sensing, particularly sensing human attention. My research is oriented around building effective deep learning models with eye tracking data to detect suboptimal user attention patterns in AR and to integrate such models into AR systems to provide real-time feedback to users and mitigate potential safety risks by adaptively adjusting AR content. I'm also broadly interested in other aspects of safe AR systems, including but not limited to semantic sensing of the physical environment, securing AR-based human-robot collaboration and edge-assisted AR applications.

EDUCATION

Duke University
Ph.D. Candidate, Computer Science

Aug. 2022 – Present
Durham, NC, USA

- **GPA**: 4.0/4.0
- **Advisor**: Prof. Maria Gorlatova

Shanghai Jiao Tong University
Bachelor, Computer Science and Engineering (IEEE Honor Class)

Sep. 2018 – June 2022
Shanghai, China

- **GPA**: 3.8/4.3

RESEARCH EXPERIENCE

Modeling Situational Awareness in AR-Guided CPR
Intelligent Interactive Internet of Things Lab

Oct. 2024 – Present
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.
- Identified that **slower and shorter saccades** and **longer time fixated on virtual content** were correlated with situational awareness based on 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.

Analyzing and Predicting the Distraction Potential of Augmented Reality
Intelligent Interactive Internet of Things Lab

July 2023 – Oct. 2024
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 analysis of attention patterns using **eye tracking** in AR and VR, revealing 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. The performance drop when transferring models between AR and VR further highlighted the uniqueness of AR as an interface.
- Paper was accepted to **IEEE ISMAR 2024**, a leading conference in the field of augmented and virtual reality.

Readability Controlled Open-Domain Question-Answering System on COVID-19
AI+X Project-Based Learning, NLP Program

Feb. 2021 – May 2021
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
- Collected datasets from Wikipedia and the WHO official websites to build the knowledge base (>3GB) and the dataset of QA pairs (2000+ entries)

Internship

Gematria Technologies   Sept. 2021 – Jan. 2022
Intern (Remote)   London, U.K.

- Worked on processing news articles with various tools related to **Natural Language Processing**, including 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

Teaching

- **COMPSCI 370D**: Teaching Assistant, Intro to AI (1 unit), Spring 2023
- **COMPSCI 371**: Teaching Assistant, Elements of Machine Learning (1 unit), Fall 2023

Professional Activities

Reviewer

- ACM UbiComp/ISWC 2025
- ACM Transactions on Sensor Networks 2024

Research Supervision

Ahmad Choudhary, Undergrad, Duke University   *Jan. 2025 – April 2025*
Fareeda Akewusola, Undergrad, Duke REU Program   *May 2024 – July 2024*
Ryleigh Byrne, Undergrad, Duke University   *Oct. 2023 – April 2024*

HONORS

Best Doctoral Consortium Presentation Honorable Mention   *Oct. 2024*

NSF AI Spring School Applied AI Poster Award   *Mar. 2024*

Zhiyuan College Honor Scholarship   *2019, 2020, 2021*

SKILLS

Programming: Python, C#, C++, R
Tools & Frameworks: PyTorch, Unity (MRTK, Magic Leap SDK), Vuforia, Pandas, Pingouin, pymer4, lme4 (R)
Research Methods: Human-Subjects Research, Statistical Analysis (t-tests, ANOVA, LMMs), User Study Design & Execution

Publications

Note: I primarily publish my work in *IEEE International Symposium on Mixed and Augmented Reality* (ISMAR) and *IEEE Virtual Reality and 3D User Interfaces* (VR), which are the core venues of the XR community. *ACM Symposium on Virtual Reality Software and Technology* (VRST) is also a leading conference in this `field`. I also publish in *ACM/IEEE International Conference on Information Processing in Sensor Networks* (IPSN), which is a top-tier conference in the field of sensor networks and IoT.

Work Under Review

- **[VRST25]** S. Baek, **Z. Qu**, M. Gorlatova, AR-TMT: Investigating the role of distraction type and attention control in AR visual search. Submitted to ACM VRST 2025 (July 2025).
- **[ISMAR25a] Z. Qu**, T. Hu, C. Fronk, M. Gorlatova, Will You Be Aware? Eye Tracking-Based Modeling of Situational Awareness in Augmented Reality. Submitted to IEEE ISMAR 2025 (April 2025); minor revision submitted June 2025.
- **[ISMAR25b]** C. Fronk, **Z. Qu**, M. Gorlatova, ARTOO-DARTU: Studying AR-Assisted Human-Robot Collaboration with AR Obstruction Mitigation during a Warehouse Task. Submitted to IEEE ISMAR 2025 (April 2025); major revision submitted June 2025.
- **[ISMAR25c]** T. Hu, T. Du, **Z. Qu**, M. Gorlatova, Spatial Sensing Evaluation for Multiple XR Devices. Submitted to IEEE ISMAR 2025 (April 2025); major revision submitted June 2025.

Conference Proceedings

- **[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.
- **[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**.

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.

Poster Presentations

- **[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.

Doctoral Consortium

- **[ISMAR24] Z. Qu**, Attention-Safe Augmented Reality System with Edge Computing. In Proc. IEEE ISMAR-Adjunct, Oct. 2024. **Best Doctoral Consortium Presentation Honorable Mention**.