Shakiba Davari

sdavari@vt.edu — LinkedIn — Website — Google Scholar — ORCID — Green Card Holder

STATEMENT — My work centers on the intersection of human-computer interaction (HCI), UI/UX design, and applied machine learning (ML) with a focus on intelligent extended reality (iXR) interfaces. During my PhD, I designed and implemented context-aware AR solutions to address challenges like social and visual intrusiveness, conducted mixed-methods user studies to evaluate these solutions, and developed methodological guidelines to support designing such advanced XR interfaces. My extensive experience in programming, UI/UX design, mixed-methods research, applied ML, statistical analysis, and academic writing enables me to contribute effectively to research and develop user-centered technologies.

EDUCATION

Virginia Tech, USA — 2018-2024

Ph.D. in Computer Science & Application — *Degree Received: 2024*

Dissertation Title: Intelligent Augmented Reality (iAR): Context-aware Inference and Adaptation in AR [1]

Advisor: Prof. Doug. A. Bowman

Ph.D. Committee: Dr. Missie Smith, Dr. Wallace Lages, Dr. Yalong Young, Dr. Chris North

M.Sc. in Computer Science & Application — *Degree Received: 2020*

Specialization: Human-Computer Interaction

Georgia Tech, USA — 2017-2018

M.Sc. in Computer Science

Specialization: Computational Perception and Robotics

Shahid Beheshti University, Iran — 2010-2014

B.Sc. in Computer Engineering — *Degree Received: 2014*

Major: Computer Hardware

INDUSTRY EXPERIENCE

Adobe Research — Summer 2021

Position: Research Scientist Intern

Context-Aware AR for Document Navigation

Role: Designed and developed 16 AR interfaces that use various contextual information to facilitate navigation through large document sets on iOS devices. Conducted a preliminary survey to evaluate the performance of these interfaces across multiple contexts and applied the design cycle to identify effective context-aware design principles for document navigation in each context.

Skills & Tools: Apple ARKit, Swift, Adobe Aero, 3D Interface/Interaction (3DI) design, UX design, Mixed-methods research, Statistical analysis

Microsoft Research (MSR) — Summer 2020

Position: Research Intern

Exploring the Benefits of Virtual Monitors for Low-vision Population

Role: Designed a VR tool to investigate the potential of virtual monitors as an assistive technology for low-vision users. Conducted a user study with 21 low-vision participants, from which I derived key design guidelines to enhance both hardware and software features of virtual monitors to better meet the needs of this population [7].

Skills & Tools: User-centered design, Assistive technology development, UX research, Unity Game Engine, C#, Mixed-methods research, Statistical analysis

ZIEP Technical Company, Isfahan, Iran — Summer 2013

Position: Undergraduate Intern

Role: Supported system optimization and maintenance, addressing performance issues and ensuring operational efficiency.

Skills & Tools: System Optimization, Performance Tuning, C/C++ Programming, Technical Support

Academic Research Experience

Virginia Tech — 2018-2024

Position: Graduate Research Assistant

Guidelines and Frameworks for Designing XR & iAR Interfaces

Role: Adopted a systematic approach to review and analyze the design challenges and capabilities of AR. This process involved iterative brainstorming and evaluation sessions to explore AR's diverse applications, task scenarios, and the types of data it can effectively convey. Using a comprehensive review of existing designs and research, I compiled preliminary lists of XR design elements and contextual components. These lists were continuously refined based on key AR interface features and external context factors identified in both solo and group sessions as influencing the user experience positively or negatively. This work ultimately led to several impactful guidelines, contributing to a comprehensive roadmap for intelligent AR (iAR) systems.

Key Contributions:

- **XR Design Space**: Identified the design dimensions of XR interfaces and proposed a design space for XR [3].
- **Taxonomy of Context**: Developed a taxonomy of quantifiable contextual components impacting AR efficacy [4].
- **Architecture for iAR**: Designed an architecture for context-aware inference and adaptation in iAR [4], [9].
- **Evaluation Framework for AR Input Modality**: Formulated a framework for evaluating AR input modality's effectiveness and conducted a comprehensive evaluation of the Eye input modality [2].
- **AR Interface Classification**: Proposed a classification methodology for AR interfaces and introduced "Glanceable AR" interfaces based on this classification [14], [16].

Skills & Tools: Systematic Review and Analysis, 3DI Design, Framework and Taxonomy Development

User-Specified Adaptation in Various Contexts

Role: Designed an empirical AR experiment to collect quantitative and qualitative data within a context-switching scenario. This experiment involved observing user behavior and capturing performance metrics, contextual details, and user-specified adaptations to AR interfaces across varying contexts. I conducted detailed analyses to identify patterns in user adaptations and examined their relationships to the context [4].

Key Contributions:

- **UI Design**: Informed by user adaptations, identified guidelines to improve AR interface design.
- **Data Collection**: Provided a preliminary training dataset tailored to this specific scenario for future iAR.

Skills & Tools: UX design, 3DI design, Mixed-methods research, Data analysis and Statistical analysis, Python, R, JMP, Academic writing

Adaptive XR Placement Strategy

Role: Focusing on the spatial layout of XR content, I implemented both an adaptive placement strategy and a non-adaptive "Body-Fixed" placement strategy on Microsoft HoloLens devices. I designed and conducted a

within-subjects user study to assess the effectiveness of these interfaces across four contextual scenarios, varying in social setting and user mobility [3].

Key Contributions:

- **Hybrid Frame of Reference**: Proposed using different references for each dimension of the XR object's spatial layout.
- **Environment-Referenced Placement**: Developed an adaptive placement approach using a relevant environmental object as an intermediary for positioning each XR object.
- **UI Design**: Identified guidelines to enhance AR content placement in various contexts.

Skills & Tools: Unity Game Engine, C#, Microsoft HoloLens development, MRTK, UX design, 3DI design, Mixed-methods research, Data analysis and Statistical analysis, Python, R, JMP, Academic writing

Intelligent AR for Social Contexts

Role: Designed and developed a socially intelligent AR interface for HoloLens devices. This interface uses computer vision, face detection, and speech recognition to customize AR content display based on the user's social context and needs. To evaluate this AR interface's user experience and information access efficiency relative to mobile phones, I designed, conducted, and analyzed the collected quantitative and qualitative data from a user study with 36 participants [10].

Key Contributions:

- **UI Design**: Proposed an approach for integrating social context into AR design, significantly enhancing users' efficiency and social awareness during information access compared to today's mobile phones and non-adaptive AR.

Skills & Tools: Unity Game Engine, C#, Microsoft HoloLens development, MRTK, Photon Unity Networking, Python, OpenCV, Flask web app development, UX design, 3DI design, Mixed-methods research, Data analysis and Statistical analysis, SPSS/JMP, Academic writing

Occlusion Management in AR

Role: Explored methods for managing the occlusion of real-world events in AR [11], [16]. Designed and implemented eight distinct techniques on a Lenovo Mirage Solo device and developed a simulated AR experiment to assess each technique's effect on user experience, real-world event awareness, and AR content access efficiency. Conducted a user study with 36 participants and analyzed both qualitative and quantitative data collected.

Key Contributions:

- **UI Design**: Identified guidelines to improve AR efficiency and user experience in occlusion-prone scenarios.

Skills & Tools: Unity Game Engine, C#, UX design, 3DI design, Mixed-methods research, Data analysis and Statistical analysis, Python, SPSS/JMP, Academic writing

OS-Level AR Interface

Role: As part of a team, I designed and implemented OS-level features for an AR interface on a Microsoft HoloLens device, prototyping key functionalities to enhance user interaction, spatial organization, and real-world awareness.

Key Contributions:

- **Work-Zones in AR**: Introduced the concept of work zones, each with unique app groupings and layouts customized for specific tasks, along with multiple methods for seamless switching between zones.
- **Reality Button in AR**: Developed a simple, accessible method for users to hide and restore all AR content, allowing quick focus on the real world as needed.

Skills & Tools: 3DI design, Unity Game Engine, C#, Microsoft HoloLens development, MRTK, Teamwork

Drill-AR: Enhanced Assembly Line Efficiency at Boeing Aircraft Company

Role: Collaborated as a team member to design and develop an AR interface with real-time feedback for

Microsoft HoloLens aimed at optimizing the drilling process. Conducted a user study to assess the effectiveness of the interface in improving workflow efficiency.

Key Contributions:

- **AR-Enhanced Drilling Sequence Display**: Developed an AR interface to overlay the drilling sequence directly on the plane hull, removing the need for workers to consult paper plans and streamlining the drilling process.
- **Real-Time Progress Feedback:** Provided the user real-time feedback on drilling progress to ensure accuracy.

Skills & Tools: 3DI design, Unity Game Engine, C#, Microsoft HoloLens development, MRTK, UX design, Teamwork

Integrating Everyday Proxy Objects in VR

Role: Led a team of 10 graduate and undergraduate students to explore the use of physical proxy objects in creating an engaging and immersive VR experience [12], [17].

Key Contributions:

- **Tactile Immersion through Physical Proxies**: Developed a VR experience that integrates physical objects with storytelling elements, enhancing user engagement and immersion.
- **Efficient Use of Tracking Devices**: Designed a system to reuse a single tracking device across multiple physical proxies, optimizing resource efficiency in VR environments.

Skills & Tools: Unity Game Engine, C#, 3DI design, storytelling, Leadership, Academic writing, Teamwork

Annual Participation in 3DUI Contest at IEEE VR

Role: Participated as a team member over multiple years in the 3D User Interfaces (3DUI) contest at the IEEE VR conference, contributing to 3D interface and interaction design, storytelling, programming, and writing for various team entries.

Key Contributions:

- **Best 3DUI Award 2022**: *Clean the Ocean*: Developed an immersive VR experience introducing new modifications to Go-Go and World in Miniature (WiM) techniques [8].
- **Best 3DUI Award 2021**: *Fantastic Voyage 2021*: Created an interactive VR storytelling experience to explain targeted COVID-19 vaccine delivery to antigen-presenting cells [13].
- **New Interactions and Techniques:** We introduced and developed various 3D interactions and techniques to enhance user engagement and presence in VR [5], [6], [8], [13], [15], [17].

Skills & Tools: Unity Game Engine, C#, 3DI design, Storytelling, Leadership, Academic writing, Teamwork

Stanford University 2017-2018

Position: Visiting Researcher

Leveraging Effects of Human Actions on Autonomous Cars Planning

Supervised by: Dorsa Sadigh

Role: Designed and developed driving simulation scenarios to gather driver data across diverse situations.

Skills & Tools: SimVista, SimCreator

University of Toronto 2015-2016

Position: Visiting Researcher

CARE-RATE: An online Assistive Technology Rating System for Caregivers

Supervised by: Frank Rudzicz

Role: Automated web crawling and data extraction to compile accurate, reliable information from target websites for Ludwig, a conversational robot designed to support Alzheimer's caregivers.

Skills & Tools: Selenium, Apache Nutch

InPRO: Automated Monitoring of Construction Progress Using Computer Vision and Robotics

Supervised by: Brenda McCabe

Role: Collaborated as a team member to research and implement machine learning, swarm intelligence, classification, and computer vision algorithms for automating UAV flight paths in dynamic construction environments to capture images [19], recognize construction progress states [21], [22], and automatically update the 4D Building Information Model (BIM) [18], [20].

Skills & Tools: Python2, OpenCV, Pymunck

Teaching Experience

Virginia Tech — 2018-2022

Graduate Teaching Assistant

Introduction to Artificial Intelligence — *Fall 2022 & Fall 2020 & Fall 2019 & Fall 2018*
Professionalism in Computing — *Summer 2020 & Spring 2020*
Introduction to Human-Computer Interaction and Usability Engineering — *Spring 2021*

Student Science and Technology Centre, Isfahan, Iran — 2010-2012

Instructor

Introduction to Programming, C, C++
Verilog, VHDL
RoboCup Workshop

Honors & Awards

Invited Talks

Towards Intelligent Augmented Reality (iAR): Designing Effective AR through Context-Awareness
University of Coburg — *2024*

Context-Aware Inference and Adaptation in Intelligent AR Interfaces
Workshop on Perceptual and Cognitive Issues in xR (PERCxR) at IEEE ISMAR Conference — *2022*

Awards

Winning Team for Best 3DUI Award — *IEEEVR Conference* — *2021&2022*
Departmental Service Award — *The Department of Computer Science at Virginia Tech* — *2020*
Stanford SEF Award — *Bechtel International Centre, Stanford University* — *2016*
Exceptionally Talented Student — *The Department of Engineering at Shahid Beheshti University, Iran* — *2010-2014*
Ranked 1st in Nationwide Programming Contest — *SAMA highschool, Iran* — *2009*
Ranked 3rd in Nationwide Math Contest — *SAMA highschool, Iran* — *2008*

Scholarships

Inclusion, Diversity, and Accessibility Scholarship — *IEEEVR Conference* — *2022*
Grace Hopper Celebration of Women in Computing Scholarship
Virginia Tech — *2022*
Virginia Tech — *2021*
ACM Capital Region Celebration of Women in Computing Scholarship — *Virginia Tech* — *2020*
Tapia Celebration of Diversity in Computing Scholarship
Tapia Foundation — *2020*

	Virginia Tech	*2019*
	Georgia Tech	*2017*
SAMA Fellowship in Support of High School Education	*SAMA Private School, Iran*	*2006-2010*
Ghalamchi Fellowship in Support of Preparation for National University Entrance Exam	*Ghalamchi Foundation, Iran*	*2006-2010*

Service & Professional Activities

Conference Poster Committee	*IEEEVR*	*2025*
Workshop Co-Organizer: The 1st Workshop on intelligent XR (iXR): Harnessing AI for Next-Generation XR User Experiences	*IEEE ISMAR Conference*	*2024*
Conference Poster Chair	*ACM Spatial User Interaction (SUI)*	*2024*
President of the Graduate Student Council	*Virginia Tech*	*2020*
Vice-President of the Graduate Student Council	*Virginia Tech*	*2019*
Vice-President of the Iranian Society at VT	*Virginia Tech*	*2018-2021*
System Software and Intelligent Systems Judge	*Virginia State Science and Engineering Fair*	*2020&2022*

Academic Paper Reviewer

IEEE VR	*2021&2022*
ACM CHI Conference on Human Factors in Computing Systems	*2021-2024*
ACM Symposium on User Interface Software and Technology	*2022*
IEEE International Symposium on Mixed and Augmented Reality (ISMAR)	*2020-2024*
ACM Automotive User Interface	*2020*

Mentoring:

Daniel Stover	*2022-2024*
Alexandar Giovannelli	*2021-2023*
Daniel Manesh	*2020-2021*

Memebership:

ACM Council for Women in Computing	*2019-present*
IEEE Computer Society	*2019-present*
IEEE Young Professionals	*2019-present*
Iranian Women in Computing (IranWiC), USA	*2019-resent*
Inspiring Women in Lifelong Leadership (I-WILL), Virginia Tech	*2019-2023*

Publications

[1] **S. Davari**, "Intelligent augmented reality (iar): Context-aware inference and adaptation in ar," Ph.D. dissertation, Virginia Tech, Sep. 9, 2024. [Online]. Available: https://hdl.handle.net/10919/121123.

[2] **S. Davari** and D. A. Bowman, "Evaluating input modalities in ar: A framework and a survey on eye input," *Manuscript in preparation*, Nov. 15, 2024.

[3] **S. Davari** and D. A. Bowman, "Towards context-aware adaptation in xr: A design space for xr interfaces and an adaptive placement strategy," *[Under Review] IEEE Transactions on Visualization and Computer Graphics*, Aug. 15, 2024. [Online]. Available: https://doi.org/10.48550/arXiv.2411.02607.

[4] **S. Davari**, D. Stover, A. Giovannelli, C. Ilo, and D. A. Bowman, "Towards intelligent augmented reality (iar): A taxonomy of context, an architecture for iar, and an empirical study," *[Under Review] IEEE Transactions on Visualization and Computer Graphics*, Sep. 1, 2024. [Online]. Available: https://doi.org/10.48550/arXiv.2411.02684.

[5] A. Giovannelli, F. Rodrigues, **S. Davari**, *et al.*, "Clue hog: An immersive competitive lock-unlock experience using hook on go-go technique for authentication in the metaverse," in *2023 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, IEEE, Mar. 25, 2023, pp. 945–946. DOI: https://doi.org/10.1109/VRW58643.2023.00315.

[6] L. Lane, A. Giovannelli, I. Tahmid, *et al.*, "The alchemist: A gesture-based 3d user interface for engaging arithmetic calculations," in *2024 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, 2023, pp. 1106–1107. DOI: https://doi.org/10.1109/VRW62533.2024.00347.

[7] L. Pavanatto, **S. Davari**, C. Badea, R. Stoakley, and D. A. Bowman, "Virtual monitors vs. physical monitors: An empirical comparison for productivity work," *Frontiers in Virtual Reality*, vol. 4, p. 1 215 820, 2023. DOI: https://doi.org/10.3389/frvir.2023.1215820.

[8] L. Lisle, F. Lu, **S. Davari**, *et al.*, "Clean the ocean: An immersive vr experience proposing new modifications to go-go and wim techniques," in *2022 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, 2022, pp. 920–921. DOI: https://doi.org/10.1109/VRW55335.2022.00311.

[9] **S. Davari**, "[dc] context-aware inference and adaptation in augmented reality," in *2022 IEEE Virtual Reality and 3D User Interfaces (VR)*, IEEE, Mar. 25, 2022, pp. 938–939. DOI: https://doi.org/10.1109/VRW55335.2022.00320.

[10] **S. Davari**, F. Lu, and D. A. Bowman, "Validating the benefits of glanceable and context-aware augmented reality for everyday information access tasks," in *2022 IEEE Virtual Reality and 3D User Interfaces (VR)*, IEEE, Mar. 25, 2022, pp. 336–444. DOI: https://doi.org/10.1109/VR51125.2022.00063.

[11] F. Lu, **S. Davari**, and D. Bowman, "Exploration of techniques for rapid activation of glanceable information in head-worn augmented reality," in *Symposium on Spatial User Interaction*, ser. SUI '21, Virtual Event, USA: Association for Computing Machinery, 2021, ISBN: 9781450390910. DOI: https://doi.org/10.1145/3485279.3485286.

[12] **S. Davari**, F. Lu, Y. Li, *et al.*, "Integrating everyday proxy objects in multi-sensory virtual reality storytelling," *CHI EA '21: Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems*, Jun. 25, 2021. [Online]. Available: https://epo4vr.dfki.de/assets/papers/davari2021vrstorytelling.pdf.

[13] L. Zhang, F. Lu, I. A. Tahmid, *et al.*, "Fantastic voyage 2021: Using interactive vr storytelling to explain targeted covid-19 vaccine delivery to antigen-presenting cells," in *2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, 2021, pp. 695–696. DOI: https://doi.org/10.1109/VRW52623.2021.00230.

[14] F. Lu, **S. Davari**, L. Lisle, Y. Li, and D. A. Bowman, "Glanceable ar: Evaluating information access methods for head-worn augmented reality," in *2020 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, Mar. 2020, pp. 930–939. DOI: https://doi.org/10.1109/VR46266.2020.00113.

[15] L. Pavanatto, F. Lu, **S. Davari**, *et al.*, "Get the job! an immersive simulation of sensory overload," in *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, 2020, pp. 509–510. DOI: https://doi.org/10.1109/VRW50115.2020.00106.

[16] **S. Davari**, F. Lu, and D. A. Bowman, "Occlusion management techniques for everyday glanceable ar interfaces," in *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, IEEE, Mar. 25, 2020, pp. 324–330. DOI: https://doi.org/10.1109/VRW50115.2020.00072.

[17] **S. Davari**, Y. Li, L. Lisle, *et al.*, "Save the space elevator: An escape room scenario involving passive haptics in mixed reality," in *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, Mar. 25, 2019, pp. 1405–1406. DOI: https://doi.org/10.1109/VR.2019.8798051.

[18] H. Hamledari, **S. Davari**, E. R. Azar, B. McCabe, F. Flager, and M. Fischer, "Uav-enabled site-to-bim automation: Aerial robotic- and computer vision-based development of as-built/as-is bims and quality control," *Construction Research Congress 2018*, pp. 336–346, 2018. DOI: https://doi.org/10.1061/9780784481264.033.

[19] H. Hamledari, **S. Davari**, S. O. Sajedi, P. Zangeneh, B. McCabe, and M. Fischer, "Uav mission planning using swarm intelligence and 4d bims in support of vision-based construction progress monitoring and as-built modeling," *Construction Research Congress 2018*, pp. 43–53, 2018. DOI: https://doi.org/10.1061/9780784481264.005.

[20] H. Hamledari, B. McCabe, **S. Davari**, and A. Shahi, "Automated schedule and progress updating of ifc-based 4d bims," *Journal of Computing in Civil Engineering*, vol. 31, 4 2017. DOI: https://doi.org/10.1061/(asce)cp.1943-5487.0000660.

[21] H. Hamledari, B. McCabe, and **S. Davari**, "Automated computer vision-based detection of components of under-construction indoor partitions," *Automation in Construction*, vol. 74, pp. 78–94, 2017, ISSN: 0926-5805. DOI: https://doi.org/10.1016/j.autcon.2016.11.009.

[22] H. Hamledari, B. McCabe, **S. Davari**, A. Shahi, and F. Flager, "Evaluation of computer vision-and 4d bim-based construction progress tracking on a uav platform," 2017.