Shakiba Davari

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Research Interest

Intelligent Augmented Reality (AR) Interface Design: My research interest lies in connecting my past research experience in applied machine learning (ML) and my current passion for AR interfaces. I am a 3D interaction/interface designer focusing on intelligent AR interfaces. I concentrate on different aspects of detecting AR users' context and utilizing it to adapt their AR interface. Such context-aware interfaces mitigate the existing challenges of AR, such as real-world occlusion and social intrusiveness, while providing more reliable and efficient information access and interaction in AR.

Education

Ph.D., Computer Science   **Virginia Tech (2018-Present)**
Dissertation Topic: Intelligent Augmented Reality Interfaces   *Expected graduation: Aug 2024*

MSc., Computer Science
Specialization: Human-Computer Interaction *(Degree received)*   **Virginia Tech (2018-2020)**
Specialization: Computational Perception and Robotics   **Georgia Tech (2017-2018)**

BSc., Computer Engineering   **Shahid Beheshti University(SBU), Iran(2010-2014)**
Major: Computer Hardware *(Degree received)*

Research Experience

Graduate Research Assistant   **Virginia Tech (2018-Present)**
Advisor: Doug A. Bowman
Conceptual Framework Research
I applied a methodical approach based on a) consideration of end goals, features, and challenges of AR, and b) in-depth review and analysis of existing AR interfaces, input modalities, context frameworks, and taxonomies to:

- I proposed a taxonomy of the design dimensions and adaptations of AR interfaces [1].
- I proposed a taxonomy of context specifically tailored for capturing and inferring the intricacies and features crucial to effective intelligent AR interfaces [2, 15].
- I developed a framework for context-aware inference and adaptation tailored for the creation of intelligent AR interfaces [2, 15].
- I proposed a methodology to classify AR interfaces and introduced Glanceable AR interfaces according to this classification [19].
- I proposed a guideline for evaluating and comparing AR input modalities and am currently conducting a survey on the natural AR input modalities according to this guideline [3].

Socially Intelligent AR Interfaces
- I designed and developed a socially intelligent AR interface for HoloLens devices, incorporating face and speech recognition to adapt the content and display of the information to the context.
- I designed an experiment to evaluate the effect of AR interfaces and context-awareness on the user experience and information access efficiency compared to mobile phones.

- I conducted a user study to collect quantitative and qualitative data from 36 participants.
- I published and presented the results of this work at IEEE VR 2022 [8].
Tools: Python, OpenCV, DNNs, Flask web app development, Unity Game Engine, Photon, MRTK

Teamwork
- Drill-AR: To speed up and facilitate drilling tasks at the Boeing Aircraft Company assembly line, I designed an AR interface to display the drilling sequence on top of reality using HoloLens devices.
- OS-Level AR: I designed and implemented a prototype for an AR Operating System Interface.
- I participated in the annual 3D User Interface Contest at the IEEE Conference on Virtual Reality and 3D User Interfaces (IEEE VR) as a member of various teams[14, 16, 17, 20, 21]:
  - I designed numerous 3D Interaction techniques and communicated our findings through subsequent publications.
  - I led a team of 10 graduate and undergraduate students to design an immersive VR experience using passive haptics and everyday proxy objects [18, 21].
  - Our team received the Best 3D User Interface award for two consecutive years [16, 17].

Research Scientist Intern   **Adobe Inc. (2022 May-Aug)**
Intelligent AR Interfaces for Document Navigation
- I designed and developed 16 different AR interfaces for navigation through a large number of documents on iOS devices.
- I designed and conducted a preliminary survey to explore the effectiveness of these AR interfaces in multiple contexts.
- I utilized the survey findings and iteratively applied the design cycle to select the most promising candidate interfaces and implemented them for HoloLens devices.
- I designed a user study to evaluate the effectiveness of two different AR content placement strategies on document navigation in four contexts using a HoloLens 2 device.
- I conducted the user study and collected quantitative and qualitative data from 24 participants.
- I performed several statistical significance analyses, such as non-parametric ART-ANOVA, on the study data and detailed the results in the manuscript intended for publication *[4]*.
Tools: Apple ARKit, Swift, Adobe Aero, Unity Game Engine, MRTK, JMP

Research Intern   **Microsoft Inc. (2021 May-Aug)**
Exploring the Benefits of Virtual Monitors for Low-vision Population
- I designed and developed a new tool to leverage the potential of virtual monitors for assisting low-vision users.
- I designed and conducted a user study on 21 low-vision participants.
- I derived valuable design guidelines for enhancing the hardware and software aspects of virtual monitors tailored to the needs of the low-vision population [5].
Tools: Unity Game Engine

Researcher   **Stanford University (2017-2018)**
Investigating the Effect of Leveraging Human Actions in Autonomous Cars
I designed and developed driving simulation scenarios to gather driver data across diverse situations.
Tools: SimVista, SimCreator

Exploring Automation of Construction Progress Monitoring Using UAVs

I investigated various algorithms to automate the <u>flight path of</u> *Unmanned Aerial Vehicles (*UAVs) for efficient image capture within dynamic construction sites *[11].*

Tools: Python2, OpenCV, Pymunck

Researcher   **University of Toronto (2015-2016)**

Exploring Automation of Construction Progress Monitoring Using UAVs

I combined various <u>ML classification models</u> to develop a robust system that categorizes construction site images into one of the five construction progress states *[12, 13].*

Tools: Python2, OpenCV

Online Assistive Technology Rating System for Caregivers

I automated web crawl and data extraction of target websites to provide reliable information for dementia caregivers.

Tools: Selenium, Apache Nutch

Undergraduate Intern   **ZIEP Technical Company, Isfahan, Iran (2013 May-Aug)**

I developed various low-level programming approaches for enhancing performance within Windows operating systems.

Tools: C, C++, and C# Programming

Teaching Experience

Graduate Teaching Assistant   Virginia Tech *Department of Computer Science* **(2018-2022)**
- Introduction to Artificial Intelligence (Fall 2018, Fall 2019, Fall 2020, Fall 2022)
- Introduction to Human-Computer Interaction and Usability Engineering (Spring 2021)
- Professionalism in Computing (Spring 2020, Summer 2020)

Instructor   **Isfahan, Iran (2008-2012)**
- Advanced programming, C, C++, Python, VHDL, Verilog, C# at Shakhes Institute
- C++ Programming and RoboCup workshops at Isfahan's Science and Technology Centre

Honors & Awards

- Invited Talk: "Context-Aware Inference and Adaptation in Intelligent AR Interfaces"
  Workshop on Perceptual and Cognitive Issues in xR (PERCxR) at ISMAR 2022
- Best 3DUI Award   IEEE VR 2020 and 2021
- Departmental Service Award   Virginia Tech 2020
- Grace Hopper Celebration of Women in Computing Scholarship   Virginia Tech 2021 and 2022
- Inclusion, Diversity, and Accessibility Scholarship   IEEE VR 2022
- 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, and Georgia Tech 2017
- Selected Exceptionally Talented Student in the Department of Engineering   SBU, Iran 2010-2014
- Fellowship towards preparation for Iran's National University Entrance   Ghalamchi 2006-2010
- Ranked 1st in the Nationwide Programming Exam   Nationwide Sama High School, Iran 2009

➢ Ranked 3rd in the Nationwide Math Exam	Nationwide Sama High School, Iran 2008
➢ Fellowship in Support of High School Education	Sama Private High School, Iran 2006-2010

Service Activities

➢ Poster Chair	ACM Spatial User Interaction (SUI) 2024
➢ Reviewer	

IEEE VR 2021 and 2022
ACM Symposium on User Interface Software and Technology 2022
ACM CHI Conference on Human Factors in Computing Systems 2021 and 2023
ACM SIGCHI Conference on Automotive Interfaces and Interactive Vehicular Applications 2020
IEEE International Symposium on Mixed and Augmented Reality (ISMAR) 2020 and 2021 and 2022

➢ President	Virginia Tech Graduate Student Council 2020
➢ Vice President	Virginia Tech Graduate Student Council 2019
	Iranian Society at Virginia Tech 2018 to 2021
➢ Mentoring and Advising	Danny Stover 2022-2023
	Alexander Giovanelli 2021-2022
	Daniel Manesh 2021-2022
➢ System Software and Intelligent Systems Judge	Virginia State Science and Engineering Fair 2020 and 2022
➢ Membership:	

ACM's Council on Women in Computing 2019-Present
IEEE Computer Society 2019-Present
IEEE Young Professionals 2019-Present
Inspiring Women in Lifelong Leadership (I-WILL), Virginia Tech 2019-Present
Iranian Women in Computing (IranWiC), USA 2019-Present

Publications

Journal Papers

[1] A Taxonomy of Design Dimensions and Adaptations in AR, S. Davari, DA Bowman, IEEE Transactions on Visualization and Computer Graphics(TVCG) 2024 (In-preparation)

[2] Intelligent AR: A Taxonomy of Context and a Framework for Context-Aware Inference and Adaptation, S. Davari, DA. Bowman, *IEEE CG&A* Special Issue on Next-generation Mixed-Reality User Experiences (In-preparation)

[3] An AR Input Modality Evaluation Guideline and A Survey on the Natural Input Modalities in Augmented Reality, S. Davari, Logan Lane, DA. Bowman, IEEE TVCG 2024 (In-preparation)

[4] Exploring Content Placement Strategies for Context-Aware Augmented Reality, S. Davari, DA Bowman, S. Petrangili, J. Hofswell (under-review)

[5] Virtual monitors vs. physical monitors: an empirical comparison for productivity work, L. Pavanatto, S. Davari, C. Badea, R. Stoackley, DA. Bowman, Frontiers in Virtual Reality 2023, Vol 4, 1215820

[6] Automated computer vision-based detection of components of under-construction indoor partitions, H. Hamledari, B. McCabe, S. Davari, Automation in Construction 2017, Vol 74, pp. 78-94

[7] Automated Schedule and Progress Updating of IFC-Based 4D BIMs, H. Hamledari, B. McCabe, S. Davari, A. Shahi, Journal of Computing in Civil Engineering 2017, Vol 31, Issue 4. pp. 04017012:1-16

Conference Papers

[8] Validating the Benefits of Glanceable and Context-Aware Augmented Reality for Everyday Information Access Tasks, S. Davari, F. Lu, DA. Bowman, IEEE VR 2022, New Zealand, pp. 436-444

[9] Exploration of Techniques for Rapid Activation of Glanceable Information in Head-Worn Augmented Reality, F. Lu, S. Davari, DA. Bowman, ACM Symposium on Spatial User Interaction 2021, 11 pages

[10] Glanceable AR: Evaluating Information Access Methods for Head-Worn Augmented Reality, F. Lu, S. Davari, L. Lisle, Y. Li, DA. Bowman, IEEE VR 2020, Atlanta, GA, USA. pp. 930-938

[11] UAV Mission Planning Using Swarm Intelligence and 4D BIMs in Support of Vision-based Construction Progress Monitoring and As-Built Modeling, H. Hamledari, S. Davari, O. Sajedi, P. Zangeneh, B. McCabe, M. Fischer, Construction Research Congress 2018, USA, pp. 43-53

[12] UAV-Enabled Site-to-BIM Automation: Aerial Robotic and Computer Vision-based Development of As-Built/As-is BIMs and Quality Control, H. Hamledari, S. Davari, E. Azar, B. McCabe, F. Flager, M. Fischer, Construction Research Congress 2018, Louisiana, USA, pp. 336-346

[13] Evaluation of computer vision-and 4D BIM-based construction progress tracking on a UAV platform, H. Hamledari, B. McCabe, S. Davari, A Shahi, ER Azar, F Flager, Proc., 6TH CSCE/ASCE/CRC International Construction Specialty Conference 2017, Vancouver, Canada, pp. CON106:1-10

Other Workshop and Demo Papers

[14] CLUE HOG: An Immersive Competitive Lock-Unlock Experience using Hook on Go-Go Technique for Authentication in the Metaverse, A. Giovannelli, F. Rodrigues, S. Davari, I. A. Tahmid, L. Lane, C. Conner, K. Davidson, GN. Ramirez, B. David-John, DA. Bowman, IEEE VR 2023, Shanghai, China, pp. 945-946

[15] [DC] Context-Aware Inference and Adaptation in AR, S. Davari, IEEE VR 2022, New Zealand, pp. 938-939

[16] Clean the Ocean: An Immersive VR Experience Proposing New Modifications to Go-Go and WiM Techniques, L. Lisle, F. Lu, S. Davari, I. A. Tahmid, A. Giovannelli, C. Ilo, L. Pavanatto, L. Zhang, L. Schlueter, DA. Bowman, IEEE VR 2022, Christchurch, New Zealand **[Best 3DUI Award Winner]**

[17]   Fantastic Voyage 2021: Using Interactive VR Storytelling to Explain Targeted COVID-19 Vaccine Delivery to Antigen-presenting Cells, L. Zhang, F. Lu, I. A. Tahmid, S. Davari, L. Lisle, N. Gutkowski, L. Schlueter, DA. Bowman, IEEE VR 2021, Lisbon, Portugal **[Best 3DUI Award Winner]**

[18]   Integrating Everyday Proxy Objects in Multi-Sensory Virtual Reality Storytelling, S. Davari, F. Lu, Y. Li, L. Zhang, L. Lisle, X. Feng, L. Blustein, DA. Bowman, Everyday Proxy Objects for Virtual Reality Workshop (EPO4VR) @ ACM CHI 2021, 4 pages

[19]   Occlusion Management Techniques for Everyday Glanceable AR Interfaces, S. Davari, F. Lu, and DA. Bowman, Workshop on Everyday VR (WEVR) @ IEEE VR 2020, USA, pp. 324-330

[20]   Get the job! An Immersive Simulation of Sensory Overload, L. Pavanatto, F. Lu, S. Davari, E. Harris, A. Folino, S. Imamov, S. Chekuri, L. Blustein, WS. Lages, DA. Bowman, IEEE VR 2020, Atlanta, GA, USA. pp. 509-510

[21]   Save the Space Elevator: An Escape Room Scenario Involving Passive Haptics in Mixed Reality, S. Davari, Y. Li, L. Lisle, F. Lu, L. Zhang, L. Blustein, X. Feng, B. Gabaldon, M. Kwiatkowski, D. A. Bowman, IEEE VR 2019, Osaka, Japan, pp. 1405-1406