

# Shirin Hajahmadi

**Position:** Ph.D. student, Department of Computer Science and Engineering

**Affiliation:** VARLab, University of Bologna

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**Google Scholar:** Google Scholar Profile



## Personal Statement

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My research and skills are focused on the intersection of Computer Science, Human-Computer Interaction, Cognitive Psychology, Extended reality (XR) applications, and sensor technologies. I design, develop, and evaluate XR applications that help people practice critical skills for life and performance improvement. My research also emphasizes privacy and security within XR paradigms, exploring how these critical factors impact user autonomy, data protection, and the ethical deployment of immersive technologies.

## Education

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### Ph.D. (in progress)

Department of Computer Science and Engineering/VARLab/Alma Mater Studiorum-University of Bologna

*Bologna, Italy*

*Nov. 2021 - Current*

- **Field of study:** Computer Science
- **Research study:** Design, development, and evaluation of XR applications for the enhancement of cognitive functions.
- **Relevant Coursework:** Human-Computer Interaction, User Interface & Software Technology, Designing Distributed Geospatial Data-Intensive Applications, Data visualization for scientists, Low-rank Approaches for Data Analysis: Models, Numerical Methods and Applications, Warehouse-Scale Computing, Internet of Things, From Big Data to Data Platform - Research and Challenges, Introduction to Reinforcement Learning, Applied Machine Learning, Scientific Writing and Publishing, Methodological foundations in experimental studies with humans.

### Master of Science

Institute for Cognitive Science Studies / Shahid Beheshti University

*Tehran, Iran*

*Oct. 2016 - Jan. 2019*

- **Field of study:** Cognitive Science (Cognitive Psychology)
- **Relevant Coursework:** Fundamentals of Cognitive Neuroscience, Cognitive Development Psychology, Principles of Cognitive Linguistics, The Basics of Psychological Pathology, Psychology of Cognitive Development, Mind and Consciousness, Cognitive Approach to the Education of Children with Special Needs, Laboratory techniques in Cognitive Psychology, Statistical Methods in Cognitive Science.
- **Thesis:** Map-based alignment effects on the virtual spatial navigation in complex curved layouts.
- **Description:** This project explored the effects of map-based alignment strategies on navigating virtual spaces with complex curved designs, providing a deeper understanding of human cognitive mechanisms and enhancing user interaction within digitally complex environments. As self-similarity and symmetry are two features of fractal geometry, I was inspired by a well-known Iranian fractal design in the city of Isfahan, called Hasht Behesht palace (meaning Eight Paradises), to be able to mathematically measure and, therefore, control for the complexity of the environment by its fractal dimension.

### Bachelor

Shahid Bahonar University

*Kerman, Iran*

*Feb. 2006 - Apr. 2010*

- **Field of study:** Computer Science
- **Relevant Coursework:** Principles of Computer, Operating Systems, Databases, Software Engineering, Computer Logic, Computer Architecture, Design & Analysis of Algorithms, Data Saving & Recovery, Computer Networks, Artificial Intelligence, Theory of Automata and Languages, Numerical Analysis, Discrete Mathematics, Compiler Construction, Statistics & Probability, General Mathematics, Basic Physics, Electricity & Electronics Physics lab, Numerical Linear Algebra.
- **Thesis:** Toward the design and development of lexical and syntactic compilers.
- **Description:** This project encapsulates my endeavor in architecting and engineering compilers with a focus on lexical and syntactic analysis.

## Summer Schools

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- **Emotional Ergonomics in Virtual Immersive Environment (EEIVE)**

University of Milan, Milan, Italy

21-23 June 2023

**Key Focus:** Virtual Reality, Affective Computing, Sensing Technologies, Brain-Computer Interfaces, and Ethics in New Technologies.

- **7th Advanced Course on Data Science & Machine Learning (ACDL2024)**

Riva del Sole Resort & SPA, Castiglione della Pescaia, Tuscany, Italy

10-14 June 2024

**Key Focus:** Deep Learning, Data Science, Generative AI.

## Professional Experience

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### Research Visit

University of Hamburg, Department of Informatics

Hamburg, Germany

September. 2023, November. 2023

- Developing user-centric bi-manual interaction techniques for Virtual Reality, aimed at enhancing accessibility for users with upper limb loss, utilizing advanced technologies.
- Exploring the influence of Mixed Reality (MR) virtual assistants on social dynamics, engagement, and performance in a puzzle-solving task.

### Research fellow

University of Bologna, Anastasis Srl, Progetto: COMponenti tecnologiche PeR l'inclusionE Nella Didattica e nella fOrmazione (COMPRENDO)

Bologna, Italy

Mar. 2020 - OCT. 2021

- Developing a desktop game for improving executive functions for children with Autism.
- Developing an MR app (with Hololens2) to overlay metadata on a photo family album.

### Research Assistant

Shahid Beheshti University

Tehran, Iran

Feb. 2019, Mar. 2020

- Design and development of VR applications for cognitive enhancement with a focus on virtual spatial navigation.

## Fellowship & grants

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2023-2024	<b>Marco Polo Incentive Fellowship</b> , From the University of Bologna, to support research studies abroad.
2021-2024	<b>Ph.D.Scholarship</b> , From the University of Bologna, for supporting a Ph.D. in Computer Science and Engineering.
2021-2024	<b>Winner of ISA Fellowship</b> , From the University of Bologna, Institute of Advanced Studies (ISA), International PhD college.
2020-2021	<b>Research Fellowship</b> , From Emilia-Romagna Region - On design and implementation of Augmented Reality applications for educational contexts.
2019	<b>Grant</b> , From the Cognitive Sciences and Technologies Council of the Vice Presidency of Iran, for organizing and holding the workshop series on task designs in Spatial Cognition Studies in the Virtual Environments.

## Publications

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### JOURNAL PAPERS

- **Hajhmedi, S.**, Calvi, I., Stacchiotti, E., Cascarano, P., & Marfia, G. (2024). Heritage Elements and Artificial Intelligence as Storytelling Tools for Virtual Retail Environments. Digital Applications in Archaeology and Cultural Heritage, e00368. Link to paper.
- **Hajhmedi, S.**, & Marfia, G. (2023). Effects of the uncertainty of interpersonal communications on behavioral responses of the participants in an immersive virtual reality experience: A usability study. Sensors, 23(4), 2148. Link to paper.
- **Hajhmedi, S.**, Ghasempouri, S., & Marfia, G. (2023). Exploring symbolic narratives in virtual spaces: Leveraging curiosity-driven design and the attention-value model for educational VR museum experiences. Mimesis Journal, 13(2), DRHA Proceedings. (In press).

## CONFERENCE PAPERS

- **Hajhamedi, S.\***, Stacchio, L.\*, Giacchè, A., Cascarano, P., & Marfia, G. (2024). Investigating eXtended Reality-powered digital twins for sequential instruction learning: The case of the Rubik's Cube. In Proceedings of the 2024 IEEE International Symposium on Mixed and Augmented Reality (ISMAR 2024). (Accepted for publication).
- Sanchez-Acedo, A., Carbonell-Alcocer, A., Cascarano, P., **Hajhamedi, S.**, Vallasciani, G., Gertrudix, M., & Marfia, G. (2024). The influence of audiovisual elements on the realism of generative AI videos: The case of Sora. In Proceedings of the CREAMI 2024 (International Workshop on Artificial Intelligence and Creativity). (Accepted for publication).
- **Hajhamedi, S.**, Clementi, L., López, M. D. J., & Marfia, G. (2024, March). ARELE-bot: Inclusive Learning of Spanish as a Foreign Language Through a Mobile App Integrating Augmented Reality and ChatGPT. In 2024 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW) (pp. 335-340). IEEE. [Link to paper.](#)
- Stacchio, L., Armandi, V., **Hajhamedi, S.**, Donatiello, L., & Marfia, G. (2024, January). M-AGEW: Empowering Outdoor Workouts with Data-Driven Augmented Reality Assistance. In 2024 IEEE International Conference on Artificial Intelligence and eXtended and Virtual Reality (AIxVR) (pp. 301-305). IEEE. [Link to paper.](#)
- **Hajhamedi, S.**, & Marfia, G. (2023, July). Toward a shared experience of uncertainty of interpersonal communication through an immersive virtual reality serious game. In International Conference on Human-Computer Interaction (pp. 566-580). Cham: Springer Nature Switzerland.
- Stacchio, L., Angeli, A., **Hajhamedi, S.**, & Marfia, G. (2021, October). Revive family photo albums through a collaborative environment exploiting the hololens 2. In 2021 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct) (pp. 378-383). IEEE.
- Stacchio, L., **Hajhamedi, S.**, & Marfia, G. (2021, March). Preserving family album photos with the hololens 2. In 2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW) (pp. 643-644). IEEE.

## POSTER PAPERS

- **Hajhamedi, S.**, Mostajeran, F., Heuer, K., Lux, A., Mends-Cole, G. O., Cascarano, P., Steinicke, F., & Marfia, G. (2024). PuzzleAide: Comparing audio and embodied assistants for MR puzzle-solving. In Proceedings of the ACM Symposium on Spatial User Interaction (SUI) (Poster presentation).
- Di Maria, G., **Hajhamedi, S.**, Sapienza, S., Marfia, G., & Palmirani, M. (2024). XR4LAW: Implementing an immersive ergonomic user interface for legislative and deliberative institutions. In Proceedings of the ACM Symposium on Spatial User Interaction (SUI) (Poster presentation).

## Skills

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### MENTOR& PROJECT LEAD

- Conducting research and leading a multidisciplinary research team comprised of undergraduate and master's students from diverse academic backgrounds such as computer science, cognitive psychology, and fashion studies.

### RESEARCH

- Rapid Prototyping, pilot studies, qualitative & quantitative user research, usability testing, user interviews and surveys research, physiological analysis, academic writing.

### DESIGN

- **Task Design:** For the empowerment of cognitive abilities using XR.
- **User Experience (UX) Design:** User Interface Design, Interaction Design.
- **Prototyping:** Sketches and mockup videos, wireframe, storyboard.

### HARDWARE & SOFTWARE

- **XR Development Proficiencies:** Skilled in utilizing a comprehensive suite of development tools and platforms for XR applications, including Unity, Vuforia SDK, Mixed Reality Toolkit (MRTK), ARFoundation SDK, SteamVR SDK, OpenXR SDK, Photon SDK as well as hardware such as Hololens, Oculus, HTC Vive, Android smartphones, the EMG (Electromyography) Trigno Light System for electromyography analysis, the Qualisys Motion Capture System for precise movement tracking, and Kinect for depth sensing and motion detection.
- **Software Development Proficiencies:** Proficient in a diverse range of programming languages, including C# (primarily for Unity development), Python (for data analysis and machine learning), C++ (for system/software development), Java, and Kotlin (for Android app development), Arduino (for IoT projects), and HTML (for web development).

- **Machine learning:** Proficient in Machine Learning principles and algorithms, with experience applying techniques to data sets.
- **Design & prototyping:** Experienced in using Figma, SketchUp, Kdenlive, and Audacity for high-fidelity design and audio editing.
- **Statistical analysis:** Skilled in data analysis and statistical modeling using R and Python.
- **Cognitive Measurements:** Knowledgeable in utilizing EMG, Qualisys Motion Capture System, Kinect, and eye-tracking technologies to facilitate cognitive research and enhance user testing methodologies.

## COMMS

- **English:** C1 (Working Proficiency)
- **Farsi:** C2 (Native Speaker)
- **Italian:** A2 (Elementary Proficiency)

## Lecturing, Teaching, and Mentorship

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- **Workshop Lecturer,** Unity for creating virtual environments (essentials) and the implementation of an example Unity project, part of the "eXRAI: Exploring XR and AI in the Creative Industries workshop", sponsored by the Department of the Arts, University of Bologna, and University of Rey Juan Carlos, Madrid. (6 hours) Bologna, Italy, 2 - 4 July 2024.
- **Mentorship,** A group of Bachelor students at the University of Hamburg, Investigating social dynamics and performance in a Mixed Reality puzzle activity using different types of virtual assistants, Hamburg, Germany, 2023-2024.
- **Mentorship,** Maryam Arjomandi, Master thesis in fashion studies, a VR fashion experience inspired by "Alice in Wonderland," innovatively blending technology, narrative, and design to transform users into active participants in a story-driven exploration of fashion. Bologna, Italy, 2022-2023.
- **Mentorship,** Igor Iurevici, Master thesis in Computer Science and Engineering, Exploring user enactments in VR, leveraging virtual smart home environments to assess new technologies' impact on user perceptions and interactions, Bologna, Italy, 2022-2023.
- **Mentorship,** Ranim Elnabouche, Master thesis in fashion studies, Exploring the transformative potential of a virtual fashion show as a gateway to personalized avatar customization, to revolutionize audience engagement and reflect personal identity and style preferences. Bologna, Italy, 2022-2023.
- **Mentorship,** Yue Chen, Master thesis in fashion studies, Exploring the potential synergy between curated retail and the metaverse to redefine consumer engagement, Bologna, Italy, 2022-2023.
- **Teaching,** Virtual Reality (VR) and Augmented Reality Laboratory course, MS in Computer Science Bologna, Italy, 2019-2023 | 11 hours of instruction.
- **Teaching,** Data Science and Immersive Technologies for Fashion E-commerce course, MS in fashion studies, Rimini, Italy, 2020-2022 | 10 hours of instruction.
- **Teaching,** Advanced Information and Communication Technologies course, MS in fashion studies, Rimini, Italy, 2021-2022 | 18 hours of instruction.

## Presentations

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- "Toward a shared experience of uncertainty of interpersonal communication through an immersive virtual reality serious game," Human-Computer Interaction International (HCI) conference, Copenhagen, Denmark, 26 July 2023.
- "ARELE-bot: Inclusive ELE Learning with AR and ChatGPT," Seminar organized by the GRLMC-Research Group on Mathematical Linguistics, Tarragona, Spain, 20 December 2023.
- "Exploring Symbolic Narratives in Virtual Spaces: Leveraging Curiosity-Driven Design and the Attention-Value Model for Educational VR Museum Experiences." Presented at the Digital Research in the Humanities and Arts Conference (DRHA), Turin, Italy, 13 September 2023.

# Projects

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## 1. Exploring the influence of MR virtual assistant modes on social dynamics, engagement, and performance in a puzzle-solving task

Hamburg, Germany

### About:

Oct. 2023 - Current

- **Software and technology applied:** The experience is created using Unity, and MRTK. The application runs on HoloLens 2.
- **Programming languages used:** C#.
- **My role:** Project leadership, task and usability design, software design, development, and evaluation.

## 2. Using XR for learning Rubik's Cube solving techniques

Bologna, Italy

### About:

June. 2023 - Current

- **Software and technology applied:** The experience was created using Unity 3D for design and development, complemented by Python to support server-side operations. The application runs on Varjo and Giiker Super Cube I3Se.
- **Programming languages used:** C#, Python.
- **My role:** Task and usability design, and evaluation.

## 3. Developing user-centric bi-manual interaction techniques for VR, aimed at enhancing accessibility for users with varied upper limb capabilities, utilizing advanced technologies

Hamburg, Germany

### About:

Sep. 2023 - Current

- **Description:** VR studies often exclude those with upper limb differences due to bi-manual interaction. This research develops tailored techniques to enhance accessibility, aiming to support equal participation in VR experience.
- **Software and technology applied:** Unity 3D, OpenXR API, EMG Trigno Light System API, Qualisys motion capture camera system API, Kinect SDK, Oculus Quest 3, EMG Trigno Light System, Vive tracker, Kinect, and Qualisys motion capture camera system. The project runs on Oculus Quest 2 and 3.
- **Programming languages used:** C#, Python.
- **My role:** Task and usability design, application design, and development.

## 4. A virtual museum experience that provokes curiosity to drive the user's attention for an effective learning experience

Bologna, Italy

### About:

May. 2023 - Current

- **Description:** In this project, we developed an immersive VR project inspired by Italo Calvino's 'Invisible Cities', merging narrative, puzzle elements, and symbolic storytelling to deepen engagement, valuable for educational technology researchers and museum educators.
- **Software and technology applied:** Unity 3D and SteamVR SDK are used for designing and making the environment. The application runs on HTC Vive.
- **Programming languages used:** C#.
- **My role:** Project leadership, task design, application design, and development.

## 5. An AR language learning application with a virtual assistant for students with dyslexia.

Bologna, Italy

### About:

March. 2023 - Current

- **Description:** This project introduces ARELE-bot, an inclusive mobile application integrating AR and ChatGPT for linguistic education, designed to meet the specific needs of students with dyslexia, aiming to enhance the learning of Spanish as a Foreign Language (SFL) and foster positive attitudes towards SFL.
- **Software and technology applied:** Android studio software is used to create the experience. The application runs on Android smartphones.
- **Programming languages used:** Kotlin, JavaScript.
- **My role:** Project leadership, task and usability design, application design, and development.

## 6. A virtual office experience exposes the user to two levels of uncertainty in interpersonal communication when accompanied by an embodied virtual user.

Bologna, Italy

### About:

Dec. 2022 - Feb. 2023

- **Description:** This project introduces a shared immersive VR serious game platform to study behavioral responses to uncertainty in interpersonal communication.
- **Software and technology applied:** Unity 3D, SteamVR SDK, Photon SDK, and ReadyPlayerMe tool were used for designing and making the environment. The application runs on HTC Vive.
- **Programming languages used:** C#.
- **My role:** Project leadership, task and usability design, application design, development, and evaluation.

## 7. An outdoor AR application for a workout experience with data-driven Augmented Reality assistance.

Bologna, Italy

Sep. 2021 - Jul. 2022

### About:

- **Description:** This project introduces an AR system, aimed to enhance high-intensity sports activities like jogging and workouts with a dynamic virtual interface, offering real-time guidance and adaptability to various AR headsets.
- **Software and technology applied:** The experience was created using Unity 3D for design and development, complemented by Python to support server-side operations. This application runs on Magic Leap 1.
- **Programming languages used:** C#, Python.
- **My role:** Task and usability design, application design, and evaluation.

## 8. A working prototype of an AR pdf viewer.

Bologna, Italy

Nov. 2021 - Mar. 2022

### About:

- **Description:** This project explored developing an MR PDF viewer, enabling users to download, view, and navigate PDF files on a HoloLens device with hand gestures and voice commands.
- **Software and technology applied:** Unity 3D was used for designing and making the experience, integrating pdf renderer and MRTK SDKs. The application runs on HoloLens 2.
- **Programming languages used:** C#.
- **My role:** Application design, and development.

## 9. An AR application to revive Family Photo Albums through a Collaborative Environment.

Bologna, Italy

Jan. 2021 - OCT. 2021

### About:

- **Description:** This project introduces an AR application utilizing AI to explore photo album content, featuring DL-based object detection and client-server paradigm.
- **Software and technology applied:** Unity 3D and Vuforia SDK were used for designing and making the experience, complemented by Python to support server-side operations. The application runs on HoloLens2.
- **Programming languages used:** C#, Python.
- **My role:** Development.

## 10. A desktop game to be used in training courses for children with special needs.

Bologna, Italy

Mar. 2020 - OCT. 2021

### About:

- **Description:** A desktop game designed for training children with Autism, featuring cognitive rooms focusing on various skills like visuospatial and audio-verbal interference control, working memory, and cognitive flexibility.
- **Software and technology applied:** Unity3D was used to develop the application. The application runs on a desktop PC.
- **Programming languages used:** C#.
- **My role:** Application design, and development.

## 11. A VR application that challenges the user to accomplish a navigational task inside a building characterized by a complex curved layout and misaligned maps

Tehran, Iran

Oct. 2018 - Jan. 2019

### About:

- **Description:** This study investigates the misalignment effect on spatial navigation using HMD-VR headsets, finding differences in participant behavior based on misalignment degrees.
- **Software and technology applied:** Unity 3D, SteamVR SDK, and SketchUp software were used for designing and making the environment. The application runs on HTC Vive.
- **Programming languages used:** C#.
- **My role:** Project leadership, task and usability design, application design, development, and evaluation.

References available upon request.