USC Interaction Lab & CSULA XP Lab

Communicate, Share, Adapt: A Mixed Reality Framework for Facilitation Robot Integration and Customization

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Learn more on our NRI 2.0 grant website: https://tinyurl.com/NSF-SVTE

Objective

Develop a Shared Virtual Teaching Experience (SVTE) leveraging the immersive interaction potential of virtual and augmented reality (VR and AR) to: teach users how to communicate with robots, build user-robot rapport through sharing, and adapt robot behavior for real-world interactions based on the training from the immersive experience. Validate with older adult users.

Background and Motivation

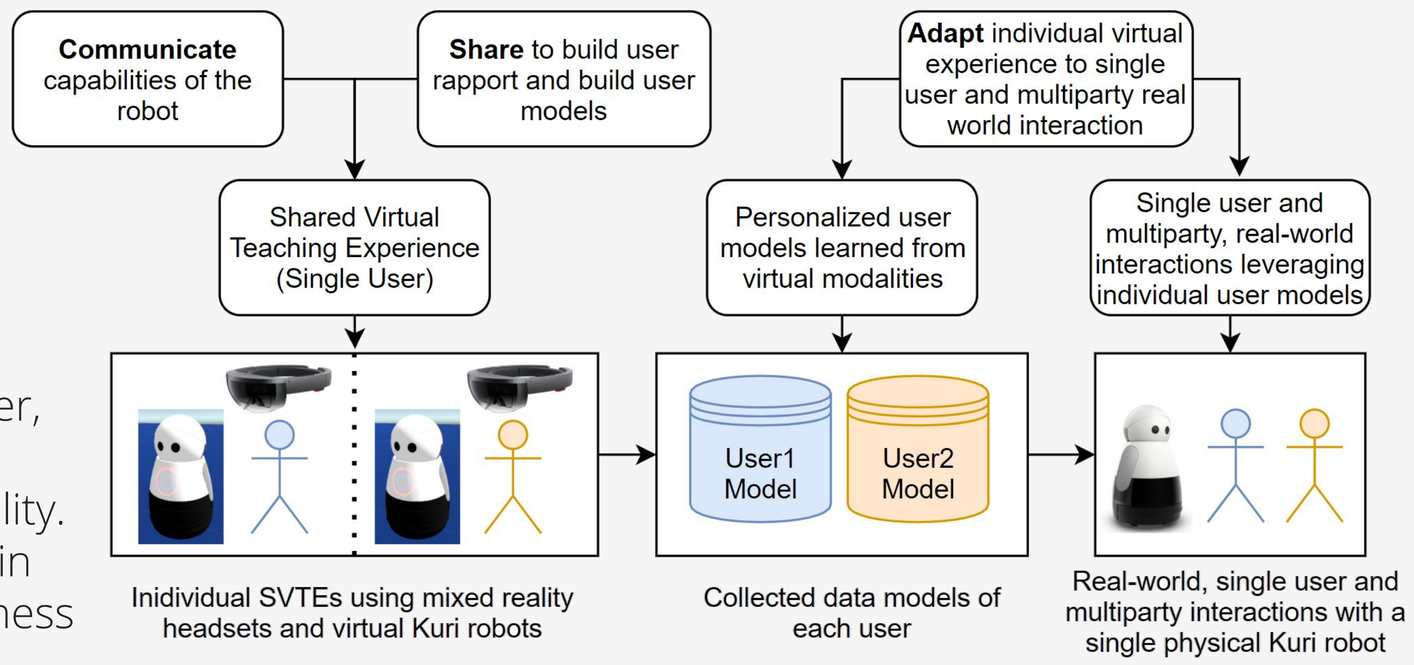
- Research has consistently found that older adults are open to using robots as companions, but that they want robots to perform at the level of a human caregiver, specifically in ways that require more advanced social skills [1].
- The significant need for personalized integrated co-robots for the rapidly growing elderly population requires natural bi-directional communication, but key barriers include limited perception and signaling affordances of robots [2].
- Users do not understand robot limitations, leading to frustration and abandonment of co-robots [3].
- Using immersive technologies to enable non-experts to communicate in HRI contexts has shown promise; studies have explored showing users camera views from the robot [4] and natural deictic gestures [5].
- A key challenge for human-machine interaction in general and HRI in particular is *personalization* to the user [6], where the data-rich environment of mixed reality could be explored.

SVTE Interaction Setup

Users first take part in the SVTE in a head-mounted display (HMD), engaging in a collaborative task with the robot. The user model obtained from the virtual experience is then transferred to the physical robot for one-on-one and multiparty interactions.

Real World Model Transfer

During the SVTE, the robot develops a model of the user, consisting of the user's understanding of the robot's capabilities and details of the user history and personality. We explore how the robot can make use of the model in the physical world to improve the quality and effectiveness of one-on-one and multiparty interactions.

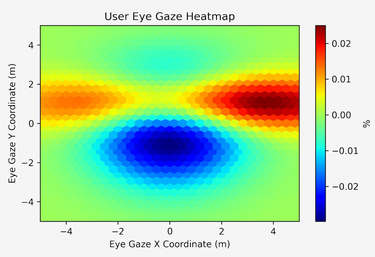


Results To Date

Conducted design interviews with older adults aged 75 to 87 at the Front Porch retirement community in Los Angeles. Conducted a user study that tracked and scored different data modalities from the MR headset worn by students completing coding exercises within MoveToCode [7], a block-based visual programming language we developed. We analyzed the behavioral data for correlations with usability survey data, finding that gaze was predictive of post-interaction scores [8].

Partner Institution

Interview participants from Front Porch

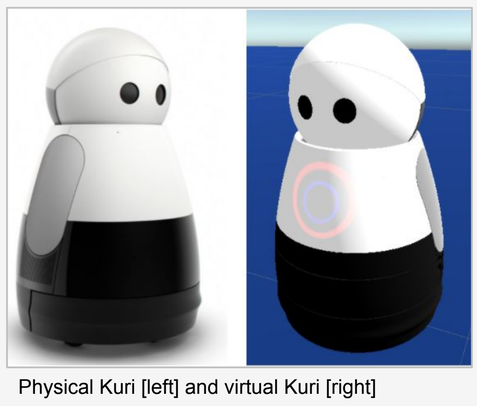


Eye Gaze heat map data from MoveToCode study

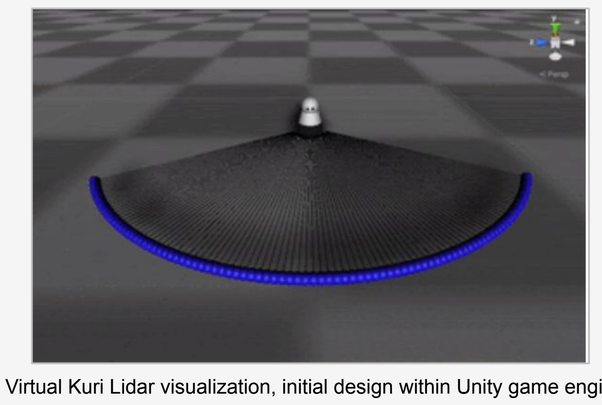
MoveToCode block-based programming in mixed reality; external view of participant [left] and view through mixed reality headset [right]

Current Work

- Creating a one-to-one virtual Kuri robot in the Unity game engine for deployment to multiple mixed reality headsets.
- Designing different sensor visualizations for non-expert users such as laser scan visualizations for Kuri within Unity to improve transparency for non-expert users.
- Experimental visualizations are being further designed for an online study informed by the interview insights.



Physical Kuri [left] and virtual Kuri [right]



Virtual Kuri Lidar visualization, initial design within Unity game engine

Outreach

- "Human-Robot Interaction & Socially Assistive Robots" talk at Laguna Woods Village elder care facility (~70 people).
- "What is a Socially Assistive Robotics Ph.D.?" virtual talk for Temple City High School (~20 people).
- 2020 Virtual Robotics USC Open House talk and mixed reality demo on showcasing this work (~50 people).
- Family Robotics Night demos as Monterey Hills Elementary School showcasing MR robotics (~50 people).
- Microsoft TEALS Volunteering at Los Angeles Center for Enriched Studies high school to help both teach teachers without a computer science background how to teach computer science and teach students how to program

References

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[8] Kartik Mahajan*, Thomas R. Groechel*, Roxanna Pakkar, Julia Cordero, Haemin Lee, Maja J. Matarić "Adapting Usability Metrics for a Socially Assistive, Kinesthetic, Mixed Reality Robot Tutoring Environment", In *Proceedings of 2020 International Conference on Social Robotics (ICSR '20),* Colorado, USA, Nov 2020.