Project Outline

Collaborative Work in VR/AR/MR environment

Motivation:

- Advancement in Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) technology
- Near-seamless communication between local and remote collaborators
- Technology company providing APIs and solutions:Apple ARKit, Vuforia, Google ARCore

Objective:

- Use the rich sensory platform to design algorithms that understand group behavior to enhance collaborative work

Project Setup

Setup:

Collaborative Work in VR/AR/MR environment in Pervasive Autonomy Lab (EH 4111)

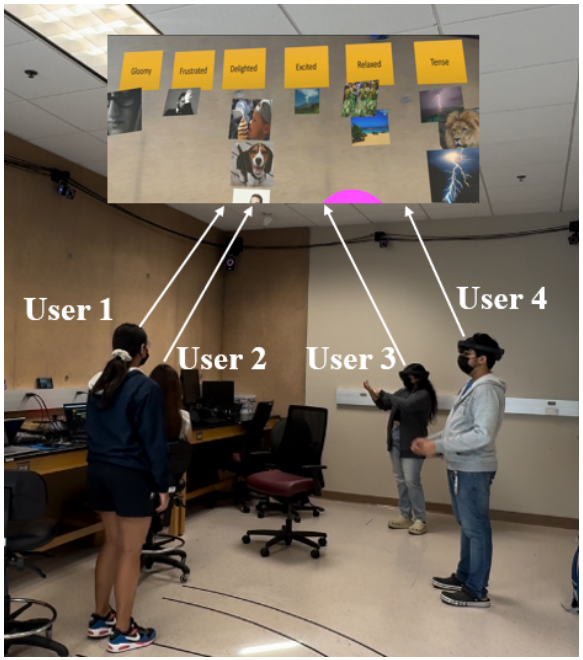
Focus: Apply algorithms you learn or design a new one!

Collaborative Task:

1. Collaboratively work on a game sorting task
2. Collect sensory data (e.g., eye gaze, location, … etc.)
3. Do some surveys
4. Use the collected data from your group/surveys (other groups if needed) to run your algorithm
5. Data will be anonymized (if you need other groups data) - more information will be shared during the experiment briefing

Learning Outcomes:

1. Get familiar with the new technology of MR
2. Work with sensor data from these new wearables (headset)
3. Apply what you learn in algorithm to design an algorithm targeting this collaborative task



Project Timeline

1. (Now-October 8) Form a team of 4 members (can not be more or less! hardware requirement). Submit names of the group in an assignment on canvas with one contact person. You can use canvas discussion to connect with your classmates to form a group.
2. (October 3- October 17) Schedule a bookable appointment through the contact person with PhD student Diana Romero https://calendar.app.google/8gkcu6RCwuC6bGt2A
3. (October 3 - October 17) Do the experiment, collect your data, do the surveys
4. (October 25)* Create a one pager proposal for the algorithm you will use for your project (some ideas will be distributed)
5. (Nov 26) Do a recoded presentation and upload it - format will be distributed
6. (Dec 3) Submit a final technical report in an ACM/IEEE format

* Second session for data collection will be granted upon approval of your proposed algorithm.

Project Ideas

Project 1: Clustering Algorithms for Participant Role Identification

- Objective: Use clustering techniques to identify the natural roles participants adopt in the collaborative sorting task.
- Data Utilization: Cluster eye gaze patterns, audio communication styles, and video-observed behaviors alongside sorting accuracy metrics.
- Analysis: Apply k-means or hierarchical clustering algorithms to group participants into roles (e.g., leader, supporter), and analyze how these roles influence overall task performance.

Project Ideas

Project 2: Network Flow Optimization for Information Sharing:

- Objective: Investigate how information flow among participants can be optimized to enhance collaborative sorting accuracy.
- Data Utilization: Use conversation data to map out communication networks, eye gaze to track attention shifts, and video to identify information exchanges.
- Analysis: Model the communication as a network flow problem and apply max-flow/min-cut theorems to optimize the information sharing pathways, reducing completion time and improving accuracy.

Project Ideas

Project 3: Collaborative Matching Algorithms for Image Sorting:

- Objective: Develop matching algorithms that optimally assign subtasks to participants based on their strengths and collaborative behavior.
- Data Utilization: Utilize eye gaze data to determine focus areas, conversation to capture communication efficiency, observing coordination, and sorting accuracy for performance metrics.
- Analysis: Apply bipartite matching algorithms to dynamically assign sorting tasks, analyzing the impact on overall sorting efficiency and accuracy.

Project Ideas

Project 4: Network Centrality and Influence on Task Performance:

- Objective: Determine the influence of central participants in the communication network on overall task performance.
- Data Utilization: Construct a communication network from conversation data, and gather sorting accuracy to measure performance.
- Analysis: Use network centrality measures to identify key participants and perform regression analysis to understand their impact on collective sorting success.

Project Ideas

Project 5: Graph Isomorphism for Experiment Comparison:

- Objective: Compare different collaborative sessions by modeling them as graphs and analyzing structural similarities.
- Data Utilization: Create interaction graphs from eye gaze and audio data for multiple sessions.
- Analysis: Apply graph isomorphism techniques to compare interaction patterns across sessions, and correlate structural differences with variations in sorting accuracy.

Project Ideas

Project 6: Minimum Spanning Tree for Optimal Interaction Pathways:

- Objective: Identify and analyze optimal pathways of interaction among participants using minimum spanning tree (MST) algorithms.
- Data Utilization: Construct weighted graphs from interaction data (e.g., communication frequency or effectiveness).
- Analysis: Apply MST algorithms to find the most efficient communication pathways and evaluate how they relate to sorting accuracy and task completion time.

Project Ideas

You can suggest you own idea!

If you need to conduct another session based on a new algorithm you developed, let us know and we can accommodate.